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STATE OF NEW YORK

DEPARTMENT OF CONSERVATION

WATER POWER AND CONTROL COMMISSION

THE GROUND-WATER RESOURCES OF RENSSELAER COUNTY, NEW YORK

By

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Prepared by the

U. S. GEOLOGICAL SURVEY IN COOPERATION WITH THE

WATER POWER AND CONTROL COMMISSION

BULLETIN GW-21

ALBANY, N. Y.

1950

STATE OF NEW YORK

DEPARTMENT OF CONSERVATION

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GROUND-WATER RESOURCES OF RENSSELAER COUNTY, N. Y.

By R. V. CUSHMAN

ABSTRACT

This report has been prepared as part of a state-wide survey of the ground-water resources of New York being made by the U. S. Geological Survey in cooperation with the New York Water Power and Control Commission. Field work was done during 1946 and 1947 when records were obtained for 700 wells, borings, and springs. Sixty-five water samples also were collected for chemical analysis.

Rensselaer County is situated within the "Capital District" in east-central New York (fig. 1). The largest city is Troy. The principal occupations are manufacturing, retail trade, and farming. The area lies partly in the Ridge and Valley physiographic province and partly in the New England upland, and comprises three topographic subdivisions—a lowland, an elevated plateau, and a succession of parallel hill ranges. The climate is a humid, modified continental type marked by long, cold winters and short, warm summers. Approximately one-fourth of the total annual precipitation generally occurs in the spring, when conditions are most favorable for ground-water recharge.

The bedrock of Rensselaer County is primarily of sedimentary origin, ranges in age from Lower Cambrian to Middle Ordovician, and consists of shale and grit, and some beds of limestone and quartzite. In many places, these consolidated rocks have been compressed into closely packed folds. Joint and fracture cleavage planes are well developed. In most of the County the bedrock is mantled by unconsolidated glacial or alluvial deposits. The unconsolidated rocks consist of till or hardpan, and stratified glacial drift.

Precipitation which falls on the immediate area is the source of all ground water in Rensselaer County. Periodic measurements of water level in a well located three miles east of Defreestville since April 1946 show the fluctation of the water table is closely related to precipitation. Stratified drift and related sands and gravels of fluvial origin are the best aquifers in the County.

Records for 30 wells ending in these deposits show an average yield of 26 gallons per minute. Larger yields may be obtained from properly constructed and developed wells. Where unconsolidated deposits are thin or otherwise unproductive, water is withdrawn from the bedrock through drilled wells. The yield of bedrock wells is small when compared to those that tap the unconsolidated deposits but is generally sufficient to satisfy small domestic and farm needs. Most industrial development is located in the urban areas, and water used for manufacturing processes is generally obtained from municipal water systems. Public water supplies of ten municipalities in the County are described.

The temperature of water from wells averages about 51° F, a few degrees above the mean annual air temperature. A number of water analyses are included to show the quality of the water and its suitability with respect to utilization. The chemical quality in nearly all cases was satisfactory for most uses. There seems to be no great difference in average content of dissolved solids in the water in bedrock and in unconsolidated materials, although individual constituents show considerable variation.

INTRODUCTION

PURPOSE AND SCOPE OF THE INVESTIGATION

In 1946, the U. S. Geological Survey began an investigation of the ground-water resources of Rensselaer County as part of a state-wide program of ground-water investigations in cooperation with the New York Water Power and Control Commission to determine the quantity and quality of ground water available in the State of New York, in order to permit a fuller utilization and conservation of the resources of the State. The areas in which ground-water studies have been completed and in which work is now in progress are shown in figure 1. Reports for Columbia, Delaware, Fulton, Greene, Montgomery, Schenectady, Schoharie, and Washington Counties are being prepared. Reports have been published for Montgomery, Monroe and Albany Counties and for parts of Broome and Cortland Counties.

Field work for this report was done in 1946 and 1947. Records were obtained for approximately 700 wells and springs, and 65 water samples were collected for chemical analysis. Part of the time was spent in the study of the glacial deposits and rock formations which are the source of the ground water.

The locations of all the wells for which records are shown are given on Plate 1. It has not been possible to check in the field the exact location of some of the wells. In many cases, only incomplete records for wells were available from well drillers and owners. A few well-drilling firms keep excellent records, but most of the drillers do not keep any records except for the depth of wells and lengths of casing used. Other details of construction are reported from memory, if at all. In general, little attention is paid to unconsolidated materials which overlie the bedrock. The necessity for detailed information about subsurface conditions for the economic development of ground-water resources, as well as for other constructive purposes, makes it advisable for well drillers to maintain complete and accurate records. By so doing they will render a valuable service to the people of the State, as well as to their own profession.

The wells have been numbered in order beginning with number Re 1, and springs have been numbered in a separate series beginning with number Re 1Sp. Although the prefix "Re" signifies that the particular well or spring is located in Rensselaer County, its use was considered unnecessary in plotting well and spring locations on Plate 1, as the plate covers only the Rensselaer County area. As an aid in reporting a well or spring location anywhere in New York State, the entire State has been arbitrarily divided into a system of rectangles, each one of which has a width of 15 minutes of longitude and a height of 15 minutes of latitude. The meridian lines forming the vertical sides of the rectangles have been lettered consecutively across the State from west to east, beginning with "A" and ending with "Z". The parallels of latitude forming the horizontal sides of the rectangles have been numbered consecutively across the State from north to south, beginning with "1" and ending with "17". This explains the "coordinate" letters and numbers appearing in the margins of Plate 1, opposite the appropriate meridians and parallels of latitude. In the tables of well and spring records each location is detailed by giving first the coordinate of one corner of the rectangle concerned, followed by two other number-and-letter combinations that indicate the distance in miles and direction from the designated corner of the rectangle to the well or spring being located. For example, well Re 12 (10Z, 12.1 N, 2.9 W) will be found 12.1 miles north and 2.9 miles west of the intersection of lines 10 and Z.

ACKNOWLEDGMENTS

The writer wishes to acknowledge the generous assistance of many federal, state, county, and municipal agencies and well drillers, well owners, and consultants, who contributed valuable information for use in this report. Among these are the New York State Department of Public Health, which analyzed water samples, the Rensselaer County Health Association, the New York State Museum, the New York State Department of Commerce, the United States Weather Bureau, and the superintendents of the various municipal and district water departments in the County. Among the well drillers whose contributions of well records form the basis of this report are: Flynn Bros., Mechanicville; Lawrence Gardenier, Nassau; Gordon Gould, Chatham Center; Hall & Co., Inc., Delmar; Ralph Jensen, Poestenkill; Frank Kornetzki, Wynantskill; James McQueen & Son, Schenectady; William Shaver, Niverville; Earl Shortsleeve, Wynantskill; Stewart Bros., Scotia; and Woodcock & Sons, Smith Basin.

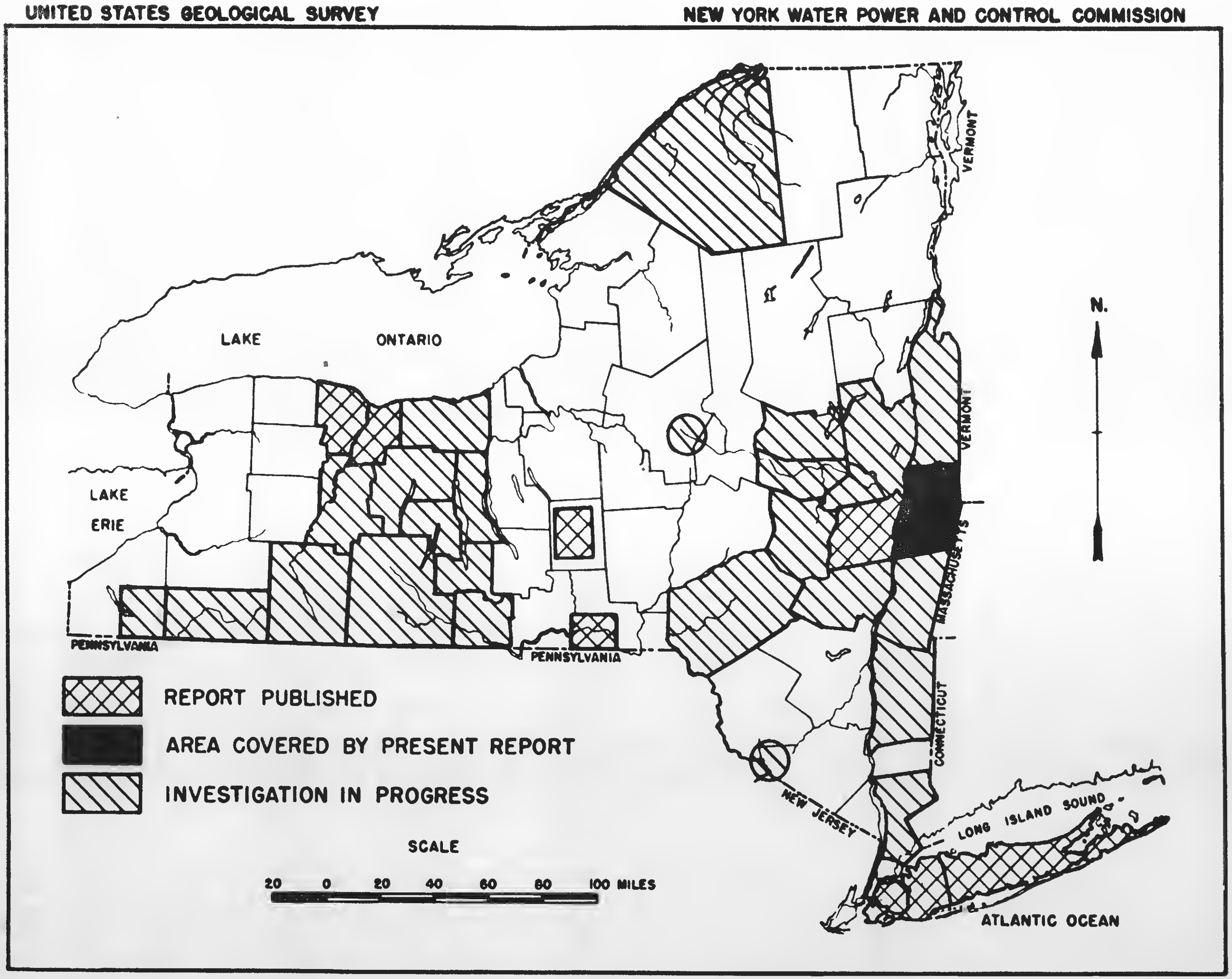

Figure 1.—Index map of New York showing coverage of cooperative ground-water studies.

Acknowledgments are made also to John C. Thompson, Executive Engineer, New York State Water Power and Control Commission; C. R. Cox, Chief, Bureau of Water Supply, Division of Sanitation, New York State Department of Health; John G. Broughton, State Geologist, New York State Museum; Dr. Meredith H. Thompson, Director of Environmental Hygiene, Rensselaer County Health Association; and the writer's colleagues in the U. S. Geological Survey, particularly E. S. Asselstine, for suggestions and assistance provided during the preparation of the report. Water samples, and well and spring records used in the report were collected by V. H. Rockefeller. R. H. Brown of the U. S. Geological Survey prepared part of the section of the report dealing with recovery of ground water. This report was prepared under the supervision of M. L. Brashears, Jr., District Geologist, in charge of ground-water investigations in New York and New England.

PREVIOUS REPORTS AND INVESTIGATIONS

The complex geology of the Taconic Range has long been a subject of controversy. The present interpretation of the rock features is an outgrowth of the varying views of many eminent geologists since the early part of the 19th century and, although far from complete, provides an adequate basis for a study of the underground-water resources. Painstaking study by Dale and others, (see references), of the stratigraphy and structure of the Taconic area, together with later work by Prindle and Knopf, (see references), has resulted in a geologic map covering the eastern part of Rensselaer County. Bulletin 285 of the New York State Museum contains a map covering the western part of the County. This map and the one by Prindle and Knopf have been used as the basis for the geologic map in the present report (pl. 2). The glacial geology of the western part of the County has been discussed by John H. Cook in, "The glacial geology of the Capital District", and a map and report on the glacial features of the Cohoes quadrangle are given in New York State Museum Bulletin 215-216 by James H. Stoller, (see references).

A brief report by the U. S. Geological Survey on the water resources of the Taconic quadrangle appeared in Water-Supply Paper 110, but at that time little was known of the distribution or quality of the underground waters of the area. The U. S. Geological Survey has on file records of the stage and discharge of the Hudson River at Mechanicville since 1883; the Hoosic River at Eagle Bridge since 1916; The Walloomsac River near North Bennington since 1931; and Poesten Kill near Troy since 1923.

GEOGRAPHY

LOCATION AND CULTURE

Rensselaer County is within the so-called "Capital District" in east-central New York. It is bounded on the north by Washington County, on the east by the States of Vermont and Massachusetts, on the south by Columbia County, and on the west by the Hudson River. Figure 1 shows its geographic location and extent of the area with respect to the remainder of New York State.

Rensselaer County has an area of 651 square miles and a population of over 120,000. The average density of population in 1940 was 187 persons per square mile, as compared to 272 for the State as a whole. Nearly one-half of the population is engaged in manufacturing or retail trade. Only about 8 percent of the employed persons in the County are farmers or agricultural workers. In 1940 there were 2,675 farms in the County, of which 92.6 percent were owner-occupied. The crops grown are hay, oats, corn, buckwheat, vegetables, and orchard fruits, mainly apples and pears. The Rensselaer Plateau, because of its poor soil coverage, has largely been abandoned by farmers and is now beginning to attract people seeking sites for summer homes. The Taconic area on the east is largely forest-covered and essentially uninhabited.

The area included in the County is divided into 14 towns and 2 independent cities. Troy, the county seat, with a population of 70,304 in 1940, is the largest and by far the most important city. It is located at the head of navigation on the Hudson River and occupies a strategic position at the eastern terminus of the New York State Barge Canal and the southern end of the Hudson-Champlain Barge Canal. It is an important manufacturing town and educational center. Among the leading articles of manufacture are collars, shirts, valves, engineering and surveying instruments. Rensselaer Polytechnic Institute, the oldest engineering school in the United States, is located in this city. Rensselaer, situated on the Hudson River opposite Albany, is a manufacturing and railroad center having a population of 10,768 in 1940. Among the larger towns in the County are Hoosick Falls, Castleton-on-Hudson, Wynantskill, and East Greenbush.

TOPOGRAPHY AND DRAINAGE

The western part of Rensselaer County is in the Hudson-Champlain section of the Ridge and Valley physiographic province, whereas the eastern part is in the Taconic section of the New England Upland. In Rensselaer County these two provinces consist of three major topographic divisions: (1) on the west a gently-sloping lowland underlain by folded beds of metamorphosed shale and sandstone, (2) on the east a succession of more or less parallel north-northeast-trending ranges composed of shale and schist, and (3) a broad, high plateau area which separates the others and is underlain by a coarse grit or graywacke (pl. 3).

The lowland area consists of a low plain bordering the Hudson River separated from a westward sloping hilly area of low relief by a well-defined escarpment ranging from 100 to 200 feet in height. The plain ranges in width from 1/4 to 2 1/2 miles, and consists of beds of sand, silt, and clay deposited in Pleistocene time in glacial Lake Albany. A trench about a mile wide and 200 feet deep has been carved out of the lake deposits by the Hudson River. Tributaries of the Hudson occupy postglacial channels and reach the Hudson over a series of waterfalls and narrow valleys cut in the surface of the old lake plain.

The altitude of the lake plain at its western edge is about 250 feet. From there, the land surface slopes gradually upward to an altitude of about 600 feet at the foot of the Rensselaer Plateau. The area is underlain by beds of folded shale and sandstone. It is mantled thinly by moraine and till, and dotted with numerous drumlins. Several larger hills composed of hard and more competent rocks rise above the lowland. The northernmost are Rice Mountain near Grant Hollow and Mt. Rafinesque east of Troy, which rise to altitudes of 900 feet and 1200 feet, respectively. Farther south is Rysedorph Hill near Rensselaer, which owes its prominence to beds of a tough conglomerate (pl. 1).

The Rensselaer Plateau has an oval shape, and covers an area of about 175 square miles extending from the Berlin-Stephentown valley west to Poestenkill and from Boyntonville and Pittstown south to East Nassau. It rises abruptly from the lowland on the west and north, and from the Berlin-Stephentown valley on the east and south. It reaches a maximum altitude in the hilly area near Bowman Pond of about 1900 feet above sea level. The plateau is characterized by a steep escarpment along its eastern edge, by low hillocks, by nearly uniform levels, and by many ponds and extensive poorly drained areas. It is entirely underlain by a coarse grit or graywacke, with intercalated beds of red and green shale. Owing to the hardness of the graywacke, the land surface has suffered little from erosion except around the outer edges where streams have cut back into the plateau.

The Taconic ranges in the eastern part of the County consist of a succession of parallel ridges with unaccordant summits, much higher than the land forms to the west, which are flanked by valleys that are generally narrow and without flood plains. The rocks underlying the Taconic area are schist, slate, and limestone of Cambrian and Ordovician age which have been intensely folded and metamorphosed. The limestones underlie the slates and crop out only in the valley areas.

Rensselaer County lies entirely within the Hudson River drainage basin. The northern part of the County is drained by the Hoosic River, and by a number of lateral streams, the more important of which are the Poesten Kill, Wynants Kill, Moordner Kill, and Kinderhook Creek. Numerous smaller streams enter the Hudson directly, having cut deep ravines in the clay terraces flanking the river. The main tributaries flow through hanging valleys into deep ravines cut into the terrace-capped shale adjacent to the escarpment. Below Schaghticoke the Hoosic River has cut a canyon nearly 200 feet deep in the bedrock. The Poesten Kill, which drains a large part of the Rensselaer Plateau, has cut a small gorge at Troy and another 2 1/2 miles to the east. All the tributaries have low gradients, except where they pass over the escarpment onto the Hudson River plain or from the high plateau to the lowlands. A large part of the drainage of the high plateau is by southward-flowing streams such as the Black River, Roaring Brook, Black Brook, and Tackawasick Creek, all of which empty into Kinderhook Creek. The remainder of the high plateau is drained by the westward flowing Poesten Kill and Quacken Kill, which have cut deep gorges at the edge of the plateau.

CLIMATE

There is considerable variation in climate throughout Rensselaer County, owing to marked differences in altitude which ranges from sea level, at the Hudson River near Troy, to about 1,900 feet above sea level on the Rensselaer Plateau, and to about 2,800 feet above sea level in the Taconic area. In general, the county has a humid, modified continental type of

climate marked by long cold winters and short warm summers. The U. S. Weather Bureau maintained a station at Troy in the Hudson River valley from 1826 to 1930, inclusive, and established one at Cherryplain in the Berlin-Stephentown valley in 1943. Mean monthly precipitation and temperature at Troy for the period 1826 to 1930 are shown in figure 2, and monthly precipitation and temperature at Cherryplain from 1943 are shown in table 1. Records for each station are representative of their respective valleys, but are only generally representative of the climatic conditions in other parts of the County. Only limited climatic data are available elsewhere in the County, but it is probable that with each increasing step in altitude the average annual temperature is lower, the precipitation greater, and the frost-free season shorter. The weather record at the Troy station is believed to be nearly representative of the more populated sections of the County.

The mean annual temperature at Troy for the period 1826-1930 is 48.8° F. The minimum temperature usually occurs in January and the maximum in July. The absolute maximum and minimum recorded temperatures are 104°F. and -24°F., respectively. The mean monthly temperatures as shown in figure 2 range from a low of 22.9°F. in January to a high 74.4°F. in July.

Table 1.—Monthly precipitation and temperature at Cherryplain, New York, for the period 1943 to 1948

(Taken from Climatological Data for New York, U. S. Weather Bureau)

Precipitation in inches

	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Annual
1943	....	....	....	....	....	....	....	7.21	1.06	4.68	6.80	0.66	....
1944	1.46	2.26	3.77	4.39	2.37	5.23	5.64	1.72	6.40	3.22	4.05	2.20	42.71
1945	4.01	2.70	2.12	7.05	6.47	6.18	10.40	2.24	4.25	1.66	....	....	....
1946	1.56	2.77	2.11	3.19	6.69	4.40	3.64	3.89	....	3.48	2.40	3.29	....
1947	4.34	2.54	2.57	4.60	5.66	4.48	5.93	6.47	3.28	2.11	5.06	2.62	49.66
1948	2.44	2.69	3.97	3.45	....	....	5.10	3.21	....	1.88	5.23	10.14	....

Temperature in degrees F.

	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.
1943	....	....	....	....	....	....	....	64.6	56.2	47.0	33.4	18.5
1944	22.6	19.5	25.8	38.4	58.4	63.2	67.4	....	58.8	46.3	35.8	21.0
1945	12.4	22.0	41.5	49.0	51.2	61.9	66.4	...	....	16.4	....	....
1946	20.7	19.2	40.8	40.0	52.0	63.1	65.8	....	....	....	39.2	26.2
1947	25.7	18.4	28.0	...	....	....	67.5	68.0	58.8	53.3	32.8	20.4
1948	13.8	17.6	31.0	....	....	....	67.1	66.5	....	....	42.7	28.0

In the Hudson River Valley the average date of the last killing frost is between April 20 and May 1; in the low plateau area, between May 1 and May 10; and in the eastern part of the County, between May 10 and May 20. The average date of the first killing frost for the Hudson River Valley is between October 10 and October 20; and for the remainder of the County, between October 10 and October 17. The length of the frost-free season in the Hudson River Valley is from 160 to 170 days, in the low plateau from 150 to 160 days, and in the highland areas from 140 to 150 days.

The mean annual precipitation at Troy is 35.57 inches, with a mean minimum monthly precipitation of 2.19 inches in February to a mean maximum of 3.78 inches in July. Precipitation is fairly well distributed throughout the year as shown on figure 2, with approximately one-fourth of the total annual precipitation ordinarily occurring in the spring when conditions

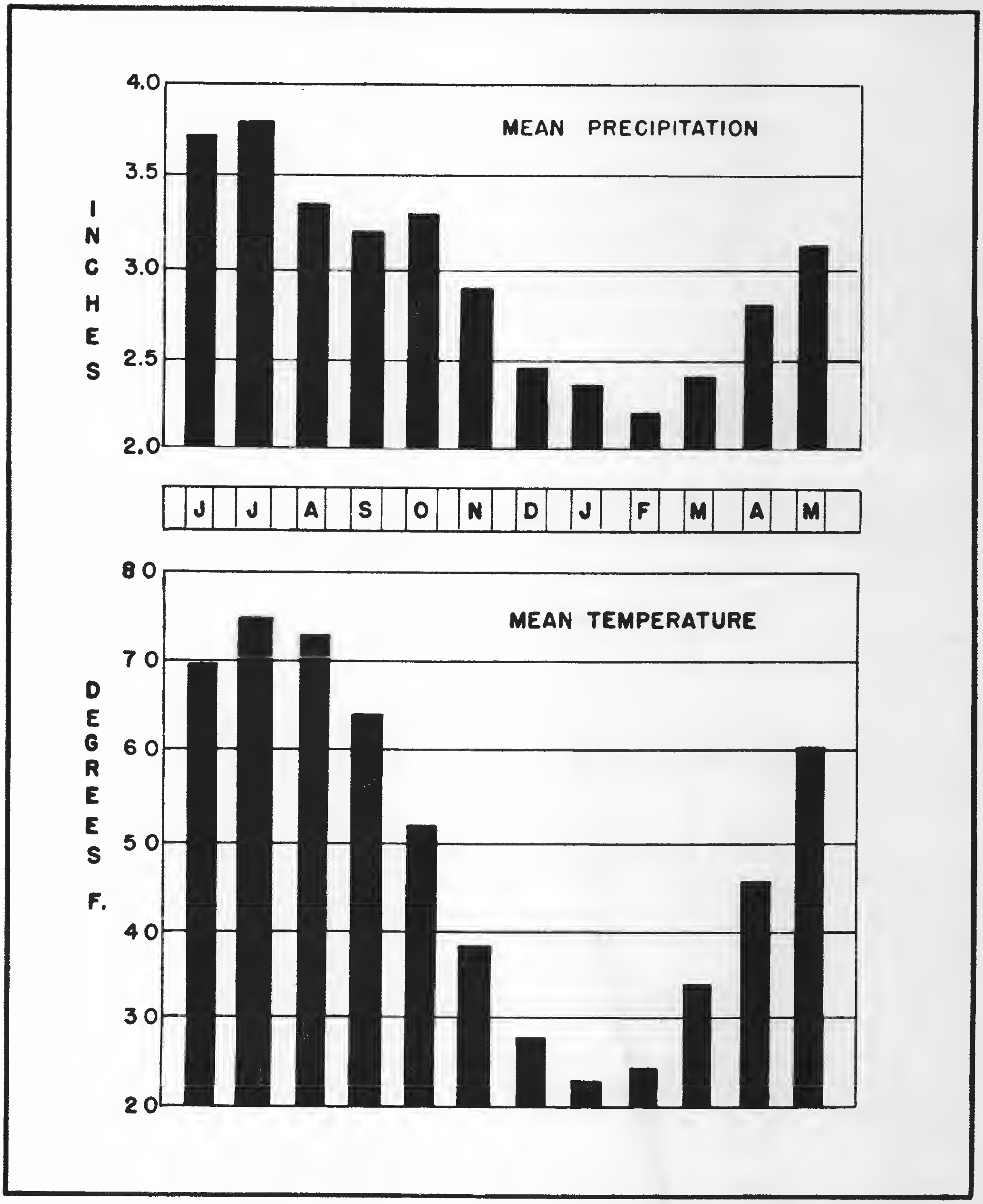

Figure 2.—Mean monthly precipitation and temperature at Troy, N. Y. for the period 1826 to 1930.

of ground-water recharge are most favorable. The greatest recorded annual precipitation at Troy, 49.16 inches, fell in 1878, and the lowest, 18.32 inches, fell in 1939. The rather long term record at Troy shows that periods of about 20 days during which the rainfall has been very slight have often occurred between March 1 and September 16. The annual snowfall at the Troy station ranges from 40 to 60 inches.

GEOLOGY

GENERAL RELATIONS OF STRATIGRAPHY AND STRUCTURE

Both unconsolidated and consolidated rocks crop out at the land surface in Rensselaer County. The unconsolidated rocks consist chiefly of stratified and unstratified deposits of Pleistocene age along with some local deposits of stream-bed and stream-terrace materials of Recent age. The consolidated sediments are chiefly shale and grit, with some beds of limestone and a few beds of quartzite. Those exposed range in age from Lower Cambrian to Middle Ordovician. The consolidated rocks, with possibly the exception of the Snake Hill formation, are not indigenous to the County, but belong to a series of formations deposited in a trough farther to the east and moved into their present position by folding and faulting along a multiple of thrust-fault planes (pl. 3). The folding and faulting greatly compressed and strengthened the sediments, and created a multitude of fractures and cracks, some of which now serve as channels for the movement of underground waters.

The stratigraphic sequence and general lithologic and hydrologic characteristics of the rocks are summarized in table 2. The major lithologic units are described in greater detail in the succeeding pages. The areas in which the various rocks crop out at the land surface are shown on plate 2 and a cross-section of the rocks in the County is given in plate 3. The four divisions of the Schodack formation of Lower Cambrian age which have been termed by Ruedemann[1] the Schodack shales and limestones, Troy shales and limestones, Diamond Rock quartzite, and Bomoseen grit, are shown as one unit, the Schodack formation, because they are closely infolded with each other and because they have similar lithology, and hydrologic characteristics. For similar reasons the Deepkill shale, in this report, is included with the Normanskill shale.

CONSOLIDATED ROCKS

For convenience the consolidated rocks are described in two geologic sequences, a western sequence and an eastern sequence, based upon the extent of the metamorphism that the rock has undergone.

Western sequence

The rocks included by the writer in this sequence are the Nassau formation and the Schodack formation of Lower Cambrian age, and the Normanskill shale and the Snake Hill formation of Middle Ordovican age. They comprise most of a broad belt of closely related rocks extending the full length of the western part of the County, north and west of the Rensselaer Plateau, from Eagle Bridge and Buskirk on the north to East Nassau and South Schodack on the south. They were formerly known as the "Georgian" or "Taconian" beds and have been described in detail by Reudemann[2]. All of these rocks are considered by geologists to be part of the great detached sheet of rocks that have been moved from their original position somewhere to the east, and thrust westward by mountain-building forces upon younger rocks native to the Hudson River Valley.

Because the formations in the western sequence consist mostly of a closely folded belt of green to black shale and have few lithologic properties that can be used to distinguish easily one formation from the other, they are here discussed as a unit. The general lithologic and hydrologic properties of each formation are summarized in table 2.

The calcareous sandstone of the Schodack formation merits individual discussion as it is of special concern to well drillers in the area. It usually consists of subrounded quartz grains cemented together by calcite, and in many places grades into a hard quartzite, the Diamond Rock quartzite of Ruedemann, in which the cement is mostly silica. The sandstone

[1]. Ruedemann, Rudolf, Geology of the Capital District, New York: New York State Mus. Bull. 285, pp. 25, 73, 79, and map, 1930.
[2]. Ruedemann, Rudolf, Geology of the Capital District, New York: op. cit. pp. 73-95.

Table 2.—Geologic formations in Rensselaer County and their water-bearing properties.

Age		Geologic formations: Western Rensselaer County	Geologic formations: Eastern Rensselaer County	Thickness (feet)	Character of material	Water-bearing properties
Quaternary	Recent	Alluvium		1 to 30	Clay and silt with some sand and gravel.	Relatively unimportant owing to small size of deposits.
Quaternary	Pleistocene	Stratified sand and gravel		Up to 120	Interbedded and interlensing sands and gravels formed by sorting action of glacial meltwaters. Frequently show crossbedding.	Important potential source of ground water. Yields moderately large supplies to properly constructed wells.
Quaternary	Pleistocene	Lacustrine deposits		Up to 150	Fine clay and silt deposited in glacial lake beds. Some sand.	Yields small supplies, but is relatively unimportant as a source of ground water.
Quaternary	Pleistocene	Till		1 to 50	Heterogeneous mixture of gravel, sand, clay, and boulders, with a predominance of clay.	Yields small supplies of water to many dug wells and for domestic and farm purposes.
Ordovician	Middle Ordovician	Snake Hill formation		3,000	Dark, gray to black, bluish and greenish shales with thin sandy and black carbonaceous bands. Beds are severely crumpled and present a "glazed" appearance along cleavage and slip planes.	Yields small supplies to drilled wells averaging 140 feet in depth; average yield 2 to 3 gallons per minute. Water is hard and often is cloudy, frequently contains hydrogen sulfide.
Ordovician	Middle Ordovician	Normanskill shale		1,300	Dark-green to black argillaceous shale containing white-weathering calcareous and chert beds. Highly folded.	Same as Lower Cambrian shales. Water may contain hydrogen sulfide.
Ordovician	Lower Ordovician		Walloomsac slate	Unknown	Dark-green, fine-grained smoothed slate broken by many joints and cleavage planes.	Yields small supplies to drilled wells averaging 180 feet in depth; wide range in yield but averages 7 gallons per minute.
Cambrian and Ordovician			Stockbridge limestone	Unknown	Massive, fine-grained, dolomitic limestone ranging from white to blue in color. Veins of calcite and quartz common. Joints well developed and some slightly enlarged by solution.	Yields moderate supplies to drilled wells which encounter fractures; 17 to 18 gallons per minute average yield. Water has moderately large concentration of mineral matter and is usually hard.
Cambrian	Lower Cambrian	Schodack formation		1,000	Greenish-gray, fine-grained, siliceous shale presenting a highly folded appearance; locally includes a brick-red weathering grit, a calcareous sandstone, a thin-bedded limestone, and red and purple shale.	Yields small but reliable supplies of ground water to many drilled wells averaging 125 feet in depth; average yield 4 to 5 gallons per minute with large range. Water moderately hard and contains some iron, but generally satisfactory.
Cambrian	Lower Cambrian	Nassau formation		400	Dark-red and green, soft shale alternating with thin beds of dark quartzite and sandstone.	
Cambrian	Lower Cambrian (?)		Rowe schist	Unknown	Grayish, greenish, or purplish chlorite schist having a squeezed and altered appearance. Well-developed cleavage and schistosity.	Unimportant as a source of ground water owing to location in county. Probable yield similar to that of Lower Cambrian shales.
Cambrian	Lower Cambrian (?)		Rensselaer graywacke	1,400	Dark-green, exceedingly tough, thick-bedded, granular grit or graywacke, in which quartz and feldspar grains are clearly visible; sometimes interbedded with thin strata of purplish, reddish or greenish slate.	Yields small but reliable supplies to drilled wells averaging 120 feet in depth; average yield 5 gallons per minute. Small range in yields.

may include beds of bluish fossiliferous limestone which generally have a brecciated or broken appearance. The sandstone and quartzite do not crop out at many places in Rensselaer County, but may be seen in Oakwood Cemetery in North Troy and in the north-northeastward trending ridge extending to Speigletown. The associated beds of brecciated limestone are exposed in the vicinity of Snyders Lake in the town of North Greenbush. These rocks are generally very hard, and when encountered in drilling may cause considerable difficulty and delay, especially if quartzite is encountered. Of the available records of wells drilled in Rensselaer County, only one well, Re 218, is known to have penetrated the hard quartzite. The drilling of this well was stopped when it encountered extremely hard rock lying 156 feet below land surface.

The thickness of the Lower Cambrian and Lower and Middle Ordovician rocks is difficult to determine because of the intense folding, the easy weathering of the shale, and the lack of reliable key beds. Ruedemann[3] estimates the total minimum thickness of the Lower Cambrian and Lower and Middle Ordovician rocks in the western sequence rocks in Rensselaer County to be at least 5,700 feet.

The structure of the shale belt, about 8 miles wide, is exceedingly complex. In general its members are arranged in ascending order from east to west with the oldest rocks, the Nassau formation lying farthest to the east. However, there is much repetition or intermingling of the various members, as shown by the occurrence of the Bomoseen grit at several localities near the overthrust line, several miles west of its normal position above the Nassau formation. The rocks have been compressed into a mass of closely-packed folds that are generally turned or tilted over westward, producing what is known as isoclinal folding, where all beds seem to incline in the same direction. The beds incline toward the east and in general strike in a north-northeast direction. Where harder and thicker beds are present, such as the dark quartzite of the Nassau formation, or the grits of the Normanskill shale, the folds are less compressed and more open. Examples of open type of folding may be seen on Curtis Mountain and in the vicinity of Hoags Corners in Nassau. The degree of metamorphism increases in an easterly direction. As a result, the rocks on the eastern edge of the shale belt have been altered to phyllites and have a slaty appearance. The folding has been further complicated by the development of extensive overthrust faults, shear zones, joints, and fracture cleavage. For the most part, the fault zones consist of numerous small fault planes which have only small insignificant openings. The joint planes are well defined and divide the rocks into rectangular blocks. Most of them dip a few degrees from the vertical and are spaced from 6 to 8 feet apart. They are well developed in the more massive, harder rocks such as the calcareous sandstone or quartzite layers in the Nassau formation. Fracture cleavage or parting of the rock into thin plates, which often obscures the original bedding planes, is well developed in all of the beds of shale. Very often several cleavage systems divide shales into stick-like fragments which lead to a quicker decay of the rock and permit easy access to downward-percolating waters.

Eastern sequence

The rocks included by the writer in the eastern sequence are the Rensselaer graywacke and the Rowe schist of Lower Cambrian(?) age, the Stockbridge limestone of Cambrian and Ordovician age, and the Walloomsac slate of Lower Ordovician age. General lithologic properties of these rocks are summarized in table 2.

The Rensselaer graywacke is one of the most conspicuous formations in the County. It forms bold cliffs around its periphery. It underlies the entire plateau, as well as several small outliers (pl. 2), and covers more than one-quarter of the area of Rensselaer County. The Rensselaer graywacke has been described in detail by Dale[4] who estimates its total thickness to be about 1,400 feet.

The age of the Rensselaer graywacke and its stratigraphic relations with adjacent formations have been a matter of speculation for many years, chiefly because no fossils have been found in it and because its contacts with other formations are obscure. Its geographic proximity to the Catskill beds of Devonian age, located on the west side of the Hudson River south of Albany, have suggested a similar age. However, evidence obtained by Prindle and Knopf[5], has led them to regard the graywacke as Lower Cambrian(?).

[3]. Ruedemann, Rudolf, Geology of the Capital District: op. cit., pp. 78, 87, 99, 118.
[4]. Dale, T. N., The Rensselaer Grit Plateau in New York: U. S. Geol. Survey 13th Ann. Rept., pt. 2, pp. 291-340, 1891-92.
[5]. Prindle, L. M., and Knopf, E. B., Geology of the Taconic Quadrangle: Amer. Jour. Sci., 5th ser., vol. 24, p. 284, 1932.

The Rensselaer graywacke does not show the intense folding and crumpling exhibited by adjacent beds of shale and slate. Rather it occurs in more open folds throughout the plateau. The graywacke has been so extensively fractured that its stratification can be determined only where it incloses beds of slate. The fractures are commonly spaced 6 to 8 feet apart and occur in two sets.

The Rowe schist forms the greater part of the Taconic Range, extending nearly the entire length of the eastern part of the County from Hoosick and North Petersburg on the north to the Columbia County boundary on the south. It crops out widely over this area, as the slopes are steep and the soil cover is thin. The age of the Rowe schist has been in doubt for many years, as fossils are not present in it and its stratigraphic relation to other rocks is not clear. Recent work in the Taconic quadrangle by Prindle and Knopf[6] has led them to regard the Rowe schist as Lower Cambrian (?) and the equivalent of the western sequence of Lower Cambrian rocks. There is a sharp increase in degree of metamorphism eastward.

The thickness of the Rowe schist is difficult to determine owing to its metamorphosed character, but it is believed that it forms the greater part of the mass of the Taconic Range, as shown by the fact that it is exposed on the north slope of the Taconic Range at the bottom of the deep valley cut by the Hoosic River east of North Petersburg.

The Stockbridge limestone is the only thick individual formation of limestone that crops out in Rensselaer County. Because of its lower resistance to erosion it is generally exposed only in the floors of the valleys. It crops out in a long narrow belt which extends from North Hoosick to Hoosick Falls, where it turns southeast to join with a broad triangular area of limestone exposed between North Petersburg and Hoosick. Farther south it crops out in the vicinity of Petersburg, Berlin, and Stephentown, where it lies between the Rensselaer grit plateau and the Taconic Range (pl. 2).

One other area of limestone of importance is the long narrow belt of dolomitic limestone, having the same lithologic characteristics as the Stockbridge limestone, which crops out along the southwest border of the Rensselaer Plateau between Alps and West Lebanon in Columbia County. This limestone has been called by Ruedemann[7] the Tackawasick limestone, but as it has nearly the same lithologic and hydrologic characteristics as the Stockbridge limestone it is here considered the equivalent of the Stockbridge as a source of ground water.

Where the contacts with adjacent rocks can be identified, the Stockbridge limestone is seen to directly underlie the Walloomsac slate of Ordovician age and overlie rocks of Lower Cambrian age. Fragmentary fossils have been found in several places in the Stockbridge limestone and these indicate that its age ranges from Lower Cambrian to Middle Ordovician, inclusively.

Lithologically, the Stockbridge is a massive dolomitic limestone, being generally fine-grained in texture and ranging in color from a pure white to bluish gray. Some beds are pure dolomite. Veins and nodules of calcite and quartz are common. It has been metamorphosed to a considerable degree, and it contains numerous intersecting systems of joints and fault cracks which permit ready circulation of water. These fissures extend from the surface to depths of as much as 300 or 400 feet, and generally become narrower with depth. They have been locally widened near the surface by weathering and erosion, forming solution channels sometimes several inches in width. No large solution caverns, such as are typical of many other limestone terranes, have been found in the County. The Stockbridge has been severely deformed and fractured and it is impossible to determine its thickness with accuracy. It is probable that its thickness varies within wide limits, and that in places it thins out to extinction.

The Walloomsac slate underlies broad areas in the Hoosick-Berlin Valley and is everywhere separated from the adjacent Lower Cambrian shale and grit by thrust faults. It lies in an elongated belt east and southeast of the Rensselaer Plateau where it forms most of the Kinderhook Creek valley southward from Berlin to the Columbia County boundary. Another large area underlain by Walloomsac reaches from Eagle Bridge to Hoosick and extends eastward to the Vermont boundary. It appears to rest conformably on the uppermost blue phase of the Stockbridge limestone. The stratigraphic position of the Walloomsac and the fossils found in it, indicate an age that is probably equivalent to that of the upper Normanskill shale of the Hudson Valley.[8]

[6]. Prindle, L. M., and Knopf, E. B., Geology of the Taconic quadrangle: op. cit., p. 290.
[7]. Ruedemann, Rudolf, Geology of the Capital District: op. cit., pp. 25, 115.
[8]. Prindle, L. M., and Knopf, E. B., Geology of the Taconic quadrangle: op. cit., pp. 274, 275.

The Walloomsac slate consists of a thick series of dark slate and possibly represents a metamorphosed phase of the Normanskill shale. The slate is greenish in color and weathers dark gray or black. The Walloomsac is traversed by numerous joints trending in several directions and is, in addition, split into thin irregular layers by cleavage planes. When exposed at the surface, these cleavage planes often become definite cracks or openings into which water may descend. Where seen in quarries, the joints are numerous and break the Walloomsac into large polygonal blocks.

UNCONSOLIDATED ROCKS

After several periods of peneplanation, the Rensselaer County region was invaded during Pleistocene time by several extensive ice sheets which were thick enough to pass over the highest peaks of the Catskill and Adirondack Mountains. The ice sheets moved across the County from the north toward the south and southeast, as is indicated by the trend of grooves and scratch marks on exposed rock surfaces, and by the elongate trend of oval hills of glacial drift known as drumlins. These ice sheets plucked rock materials from the exposed surfaces in its path, transported them for varying distances, and then deposited them as a mantle of unconsolidated materials overlying the bedrock. Some of these materials were deposited directly by the ice, and some were sorted and deposited in layers by streams flowing from the ice. The deposits thus formed consist of (1) till, an unsorted mixture of fragments ranging in size from clay particles to cobbles; (2) stratified sand and gravel laid down around masses of stagnant ice or distributed by streams issuing from the melting ice; and (3) fine-grained silt and clay deposited in lakes created by the damming of glacial meltwaters.

There are two theories concerning the manner of disappearance of the ice sheets in eastern New York. One, the "normal-retreat" theory assumes that, while the ice front retreated northward by melting, a southward movement was maintained by the pressure of the thick ice sheet, as was the case in the Great Lakes region. As melting exceeded forward motion, long ridges of unsorted glacial debris, moraines, were built up parallel to the southern edge of the ice, and outwash aprons of stratified sand and gravel were deposited farther south by meltwater streams. Valleys of north-flowing streams were dammed by the ice, and the meltwater was impounded between the ice and the valley heads. Into the lakes thus formed were deposited beds of sand, gravel, clay, and silt.

A second theory for the disappearance of the ice, as proposed by Cook[9] and Flint[10], is that the ice lost all power of movement, became stagnant, and dissipated in place. Long tongues and isolated masses of stagnant ice were thus left in existing valleys, and lakes were formed along the sides and over these lingering masses. Beds of clay and delta deposits were laid down in these marginal lakes and, after the complete disappearance of the ice, they existed as paired terraces with ice-contact slopes flanking the valleys. The subsequent melting of ice lobes, which were sheeted over with outwash material, created a "collapsed plain" or kettle and kame topography. The stagnation theory was advanced to explain the presence of such depositional features which are common in eastern New York, and the absence of continuous moraines and outwash features associated with the "normal retreat" of a glacier. Most of the glacial features in Rensselaer County suggest that the ice sheet dissipated by stagnation, and not by a gradual retreat.

Till

Till or ground moraine, locally termed "hardpan", constitutes the greater part of the unconsolidated materials in Rensselaer County. It consists of a heterogeneous mixture of rock fragments of all sizes from particles of clay and silt to cobbles and boulders. A few of the large boulders are composed of rock not native to Rensselaer County, but most of the fragments are derived from local rocks. As these consist largely of shale or slate, the till consists predominantly of clay. The thickness of the till is variable. Near the summit of the rock ridges and on the Rensselaer Plateau it is, in most places, less than 30 feet thick, and there are frequent exposures of bare rock. In the valleys and depressions, or where it occurs in the form of drumlins, it may be more than 100 feet thick. For example, wells Re 3 and Re 4 penetrate respectively 140 feet and 200 feet of hardpan without encountering rock. Till frequently occurs beneath other types of glacial deposits as evidenced by the thin layer of till sometimess encountered beneath the lacustrine clays in the Hudson River Valley.

9. Cook, John H., The disappearance of the last glacial ice sheet from eastern New York: New York State Mus. Bull. 251, pp. 158-176, Mar. 1924.
10. Flint, R. F., The stagnation and dissipation of the last ice sheet: Geog. Rev., vol. 19, pp. 256-289, 1929.

Stratified sand and gravel

The stratified glacial materials, or outwash, were deposited by streams of meltwater issuing from the ice sheets. Such deposits show a fair degree of sorting and frequently show cross-bedding and evidence of scour and fill. The grains of material vary in size from silt to coarse gravels, and the beds vary greatly in thickness, sometimes lensing out in comparatively short distances. The beds of sand and gravel, being composed chiefly of reworked ice-laid material, consist for the most part of fragments of local rocks, mostly shale. As the sorting action of the waters removed most of the clay and silt particles these deposits are generally highly permeable. Stratified drift occurs (1) as terraces and kames or irregular gravel hillocks formed by deposition around and over blocks of stagnant ice, (2) as fill in valleys whose streams carried away glacial flood-waters, and (3) as delta deposits laid down by debris-laden streams entering a quiet body of water, such as a glacial lake.

Excellent examples of each of the three types of stratified drift deposits are found in Rensselaer County. The more important areas are discussed in greater detail in the section of the report concerning the occurrence of ground water in stratified deposits. A large kame and outwash area, about 4 miles long and 1 mile wide, is situated between Wynantskill and Burden Lake. These deposits were probably laid down as sheets of glacial debris over a detached body or tongue of ice that had stagnated in the area between the Greenbush hills and the Rensselaer Plateau. Subsequent melting of the buried ice formed the kettle and kame topography characteristic of this area. Excellent exposures of beds of stratified sand and gravel can be seen in road cuts and gravel pits in the vicinity of West Sand Lake. A broad terrace of stratified glacial materials, named by Woodworth the Schodack terrace[11], occurs southwest of East Greenbush and is thought to have been formed by deposition of gravelly materials between the rock wall of the valley and the margin of a lingering ice mass in the Hudson Valley region. Its contact with the ice tongue is well outlined by the slope of the land surface from the altitude of 300 feet to 360 feet. The broad deep depressions in the otherwise even terrace level are believed to be ice-block kettle holes formed by the burial and subsequent melting of detached masses of ice.

The sand and gravel deposits in the valley of Valatie Kill in the south-central part of Rensselaer County, and the terrace deposits bordering the Hoosic River Valley between Valley Falls and North Hoosick, were laid down as marginal valley fill by debris-laden waters issuing from the melting ice sheet. Other terrace deposits of limited extent occur in the smaller valleys throughout the County.

The broad expanse of fine gravel and coarse sand extending westward from Schaghticoke in the northwestern part of Rensselaer County are delta deposits built by the Hoosic River in the body of water that occupied the Hudson Valley in late Pleistocene time. These deposits cover an area of about 20 square miles.

Lacustrine deposits

Fine-grained lacustrine deposits are well exposed in the terraced slopes of the Hudson River Valley below an altitude of about 260 feet, and in a few small alluvial flats west and northwest of the Rensselaer Plateau escarpment. It is believed that these deposits were laid down in a large body of water formed from the meltwaters of a dwindling lobe of ice which still lingered in the Hudson Valley. This Pleistocene lake is commonly called glacial Lake Albany. The lower beds consist predominantly of clay, representing the fine-grained material or rock flour that was washed from the ice and deposited in horizontal layers on the floor of the ancient rock valley. The clays are laminated and have a bluish-gray color which grades upward into a yellowish color. They compose perhaps the lower 100 feet of the lacustrine deposits. These fine clays are overlain by about 150 feet of sand and clayey sand. The upper surface of the lacustrine deposits is characterized by several more or less flat terrace levels, and by deep transverse ravines that divide the terraces into segments.

Several other small Pleistocene lake beds are situated in Rensselaer County. Two of these are situated several miles to the east and north of Troy. They are conspicuous by their flatness, as contrasted with the irregular surface of the upland country surrounding them. It is believed these lake beds were deposited when north-flowing preglacial streams were dammed by remnants of the ice sheet and glacial debris. The northernmost of these

11. Woodworth, J. B., Ancient Water Levels of the Champlain and Hudson Valleys: N. Y. State Mus. Bull. 84, pp. 122-123, 1905.

two tracts is now occupied by the waters of the Tomhannock Reservoir, a part of the public-water supply of the city of Troy. The southern tract is drained by Quacken Kill. Stoller[12] believes that a barrier of glacial material was deposited in the valley and that water was ponded north of this barrier. Only the upper part of the lacustrine deposits has been penetrated by wells. Logs of these indicate that the lake deposits consist of beds of sand, about 15 to 20 feet thick, underlain by layers of clay.

There is some evidence that a Pleistocene lake existed for a time in the Hoosic River Valley, between North Hoosick and North Petersburg. It is believed that the dam for this lake was created by stagnant ice in the vicinity of the junction of the Hoosick and Walloomsac Rivers, and that the altitude of the surface of the lake was about 550 feet above sea level. The terraces on both sides of the river south of Hoosick Falls are underlain by stratified clay and silt.

Recent alluvium

The larger streams in Rensselaer County, such as the Lower Hudson and the Hoosic and Little Hoosic Rivers, Kinderhook Creek, and Poesten Kill, and the lower courses of their tributaries are bordered by flood plains comprising a veneer of silt, clay, sand, and some gravel that were laid down by these streams in comparatively recent time. These deposits were derived from the disintegration of the bedrock and the reworking of the glacial materials, and have been spread out in flat tranverse plains or bottomlands adjacent to the parent streams. The coarser particles of the alluvium are, in general, rounded fragments of the rocks native to the region, namely, shale, slate, and grit. These deposits generally range in thickness from 10 to 50 feet and their areal extent is small.

Extensive fine-grained materials form a filling in the channel of the Hudson River from Troy southward to beyond the boundary between Rensselaer and Columbia Counties. These materials are believed to consist of fine detritus brought down by the river system above Troy and deposited in the Hudson River. These materials consist chiefly of clay and silt containing, locally, lenses of fine sand or gravel.

GROUND WATER

SOURCE

Ground water has been defined by Meinzer[13] as "that part of the subsurface water which is in the zone of saturation", but it is popularly regarded by the layman as the water that is obtained from wells and springs. Although it is pumped or issues from the ground, its source lies in the atmosphere, and essentially all ground water is derived from rain and snow. In almost all parts of the County, the underground reservoirs are replenished directly from precipitation over the immediate area, but in some of the hilly areas there is considerable underground movement before the water is returned to the surface.

That the precipitation is sufficient to meet all demands is shown by the fact that an inch of rain will yield more than 17 million gallons of water per square mile. Thus, each inch of precipitation which falls on the land surface contributes about 11 billion gallons of water to Rensselaer County. Of this, part runs off directly in the streams, a part evaporates or is transpired by plants, and the remainder seeps into the ground and recharges the water table. Although the supply of ground water generally varies directly with the amount of precipitation, other factors also control the rate of recharge. If the temperature is very high, the rate of evaporation materially decreases the potential supply of ground water. If, on the other hand, the temperature is so low that the ground is frozen, an unusually high percentage of water, finding its descent blocked, runs off directly in the streams. During the growing season the demands of vegetation, both natural and cultivated, make heavy inroads into the ground-water supply.

OCCURRENCE

All rocks, regardless of density, contain some pore spaces. Only those pores which are large enough, however, can release water to springs and wells tapping the rock. The

12. Stoller, J. H., Glacial Geology of the Cohoes Quadrangle: N. Y. State Mus. Bull. 215-216, p. 16, 1918.
13. Meinzer, O. E., The occurrence of ground water in the United States: U. S. Geol. Survey Water-Supply Paper 489, p. 38, 1923.

amount and size of the openings vary with the character of the rock, and the yields of wells are therefore directly related to the type of rock tapped. The percentage of total rock volume that is occupied by open spaces is a measure of the porosity of a rock. According to Meinzer[14] the porosity of a sedimentary deposit depends chiefly on (1) the shape and arrangement of its contituent particles, (2) the degree of assortment of its particles, (3) the cementation and compaction to which it has been subjected since its deposition, (4) the removal of minerals through solution by percolating waters, and (5) the fracturing of the rock, resulting in joints and other openings.

Although the porosity of a rock indicates the total volume of pore space available for storing water, it is necessary to use a term, called specific yield, that indicates the amount of water that will drain out of a rock because of the action of gravity. The specific yield of a rock or soil, with respect to water, is the ratio, expressed as a percentage, of (1) the volume of water which, after being saturated, it will yield to gravity, to (2) its own volume. It is a measure of the water that is free to drain out of a material under natural conditions. The value for the specific yield of a rock or soil will be less than the value for porosity since capillary forces will prevent the draining by gravity, of all the interstices or pore spaces. In addition to specific yield, the term hydraulic permeability must be introduced to indicate the capacity of the rock or soil for transmitting water under pressure. This term, however, is useful primarily when dealing with uniform unconsolidated deposits, and should be used cautiously (if at all) when the aquifer is an indurated rock which transmits water only through fractures or solution channels. In general, the smaller the interstices of a material the lower will be its specific yield and hydraulic permeability. Thus, clay and silt, which ususally have higher porosities than sand or gravel, will yield considerably less water.

The water table is an irregular surface immediately below which all rocks are saturated with water. The source of this water is rainfall which percolates down from the surface. The water table is influenced by but does not exactly reproduce the configuration of the surface topography. Depth to the water table, below the land surface, varies seasonally and annually with variations in precipitation, runoff, withdrawals by wells, temperature, and other related factors.

Under normal water-table conditions water will rise in a well to a height corresponding to that of the water table. When a water-bearing bed is overlain by impermeable beds which serve to confine the water under pressure, an artesian system is created and water will rise in the well to a level other than that of the water table, and in some cases will flow out of the well.

Shale and slate

The shale and slate of Rensselaer County have a porosity of less than one percent and the only opening capable of transmitting water are the joints and fractures in the rock. The amount of water yielded by wells in these rocks depends chiefly upon the number and size of the water-bearing fractures intersected in drilling. Because of the erratic distribution and nature of the fractures in the shales of Rensselaer County, it is extremenly difficult to predict the success or failure of a well. It is often the case that of two wells sunk within 100 feet or so of each other in the same rock, one will yield an ample supply of water, and the other will yield only a fraction of that amount. One well may be sunk in a part of the rock in which the fractures are numerous and closely spaced or it may intersect a large open fracture. On the other hand, the second well may penetrate an area of widely spread fractures or it may intersect only very narrow fractures. However, it is very seldom that a well is drilled in shale without obtaining some water. Of 306 shale wells in Rensselaer County for which complete records are available only four, or less than two percent, are recorded as yielding no water. Fourteen wells, or less than five percent were reported as yielding less than ½ gallon per minute.

A study of the records of wells which tap shales in the County reveals that most of the failures are situated west of a line formed by the break from the low plateau of the Hudson River Valley to the Hudson plain. This line follows approximately the 300-foot contour and extends from Schaghticoke on the north to Kinderhook Lake on the south. The rocks in this locality are chiefly the Normanskill shale and the Snake Hill formation, and are overlain by a thick blanket of fine lacustrine deposits. These deposits evidently have a low

[14]. Meinzer, O. E., The occurrence of ground water in the United States: op. cit., p. 3.

permeability and permit the percolation of only a small amount of water into the underlying rocks. Records for wells tapping rocks overlain by the lacustrine deposits indicate very low yields (table 8). For example, well Re 623, situated between Castleton-on-Hudson and Schodack Landing was drilled 232 feet below the land surface, or nearly 200 feet below the level of the bed of the Hudson River, without obtaining enough water to keep the drillings wet.

The well records in table 8 indicate the range in depth and yield of wells that tap shale and slate. The average depth of 328 wells, including overburden, is 127 feet. Depths range from 18 to 639 feet and the average penetration of bedrock is 88 feet. About 95 percent of the wells are less than 300 feet deep and 88 percent are less than 200 feet deep. The average yield of the 328 wells is 4.7 gallons per minute and ranges from 0 to 40 gallons per minute. Most of the records of yield are those reported by the driller, and are based on bailing tests made at the time the wells were drilled. About 92 percent of the wells yield less than 10 gallons per minute, and 73 percent less than 5 gallons per minute. Of the total number of wells, 219 or 60 percent, yield less than the average.

A summary of average depth and yield by specific formations shows very little difference between the various types of shale and slate in Rensselaer County. The average yield from the Walloomsac slate is somewhat more than 2 gallons per minute higher than the overall average, and that from the Snake Hill formation about 2 gallons per minute lower. This variation in yield can probably be explained by the difference in size of the openings or fractures in the two types of rock. The Snake Hill formation is a relatively weak rock, and, therefore, cannot be expected to maintain large open fractures, whereas the slates are hard and dense, and are thus capable of maintaining open joints and fractures.

The records show that there is a general increase in yield with increasing depths to about 300 feet. At depths greater than this there is little or no increase in yield as the number and size of the joints diminish with depth. If water is not found in a particular well within 300 feet of the surface the prospect of obtaining a supply at greater depths is poor. When drilling in shale the best sites for wells are in depressions, even minor ones, in the surface, as these generally indicate that the rock underlying them is weaker and hence more likely to be highly fractured and water-bearing than that forming the adjacent hills.

Graywacke

This rock is massive and extremely dense and hard, and has a tendency to fracture under pressure rather than to crumple or fold. Thus joints are numerous and well developed. Owing to the difficulties encountered in drilling this hard rock, only a few wells have been drilled into it. The average yield of 13 wells, known to penetrate the Rensselaer graywacke, is 5.1 gallons per minute, their average depth being 120 feet. They yield water of good quality. Before drilling into the graywacke, it is advisable to inspect the area to locate, if possible, one of the many layers of shale interbedded with the graywacke. These beds quite often stand nearly vertical and afford much easier drilling owing to their comparative softness. For example, well Re 347, situated in the graywacke area, is reported to have passed through 60 feet of green shale below about 60 feet of hardpan and boulders. This well is reported to yield 15 gallons per minute. All wells known to have penetrated the Rensselaer graywacke have yielded at least a small supply of water.

Schist

Owing to the ruggedness of the land surface in the areas underlain by the Rowe schist, there are few habitations. The steep slopes, thinly covered by till, give rise to many small springs and seeps which are utilized to a small degree for domestic and farm use. No wells are known to penetrate the schist, and little is known of its water-bearing properties. The Rowe schist is a relatively impervious rock, but it is broken by many joints and cleavage fractures, indicating hydrologic properties similar to shale and slate in Rensselaer County.

Limestone

The Stockbridge limestone is a hard compact rock, that has been subjected to considerable metamorphism and it contains very few voids. For this reason, circulation and storage of water are confined mainly to joints and fractures. Wells penetrating large fractures or solution channels can be expected to yield considerable water but will yield only small

amounts where the joints are narrow. Because of its limited area of outcrop and because of the availability of numerous small springs arising from glacial deposits in its outcrop area in the eastern part of the County, the Stockbridge limestone is little used as a source of water. Reliable records of yield are available for only 4 wells that penetrate the Stockbridge. They have an average yield of 18 gallons per minute, and range in yield from 4 to 30 gallons per minute. A fifth well which taps the Stockbridge near the Vermont boundary east of Hoosick, Re 202, is reported to yield 75 gallons per minute. This is believed to be exceptional and, therefore, has not been included in the average given above. The average depth of all 5 wells is about 200 feet. No large solution caverns, such as are typical of limestone terranes in other areas, have yet been encountered. The Stockbridge has the highest average yield of all the bedrock formations in Rensselaer County and is believed to be a potential source of moderate supplies of ground water.

Till

Till, in one form or another, although relatively impervious usually yields sufficient water to wells for general household and farm use. Ground water is usually pumped from the till by means of dug wells, which offer the advantage of a large infiltration area, a large storage capacity, and comparatively inexpensive construction cost. The water level in shallow wells of this type is usually at low stages in the summer, and many become dry during extended periods of drought. As a result, wells of this type are gradually being replaced by deeper drilled wells wherever the till is underlain by more permeable rocks. In some places, however, the underlying rocks are less permeable than the till and it is not possible to tap more productive rocks.

A few drilled wells in Rensselaer County obtain moderate supplies of water from lenses and layers of sand and gravel in the glacial till. In most cases, the water in these coarser interbeds is under artesian pressure. For example, wells Re 2 and Re 4 penetrate 76 and 200 feet of till, respectively, and are reported to give a continuous flow of water at the top of the well casing. Both wells are situated on the side of a steep hill, and are believed to have encountered one or more lenses of coarser material within the till. It is reported that the water level in well Re 2 will rise about 15 feet above the land surface. In addition, several drilled wells in Rensselaer are reported to obtain water from the base of the till at the contact with the underlying bedrock, and a few wells in the Hudson River Valley obtain water from a layer of till which lies below lacustrine clay. The average yield from 15 drilled wells which tap the till is about 10 gallons per minute. No records are available but most dug wells in till probably yield considerably less than this. Springs issue from steep banks of till throughout the County, but the flow from these is small and fluctuates with the seasons, usually drying up entirely in the summer. Many such springs issue from a contact of the till with bedrock or at the contact of a more clayey zone. A flow of about 45 gallons per minute was observed at one of the larger till springs, Re 2Sp, in May 1947.

Lacustrine deposits

Because of its very low permeability, clay is a poor water-bearing material, and, consequently, there are few records of wells ending in clay. Only one well, Re 308, is reported to yield water from clay. It is a large-diameter well used to supply boiler water for locomotives. According to the owner it yields 300 gallons per minute, but can be pumped dry in 12 hours of continuous pumping. Locally, some lenses of fine sand are included in deposits of lacustrine clay and in some cases, these, as with till, furnish small supplies of water. However, the impervious beds of clay confine the ground water in water-bearing beds beneath them, and often give rise to flowing wells. Several drilled wells in the Hudson River Valley obtain moderate supplies from layers of sand and gravel beneath lake clays.

Stratified sand and gravel

Owing to the abundance of coarse-grained particles and its well-sorted character, the beds of stratified sand and gravel are the most prolific aquifers in the County. Depositional conditions during Pleistocene time were varied and relatively complex. Because of this, the character and, consequently, the permeability of the stratified deposits differ considerably within relatively small distances, causing in some cases abrupt changes from coarse to fine materials. Data for wells ending in stratified deposits indicate an average yield of about 26 gallons per minute, the range in yield being from 1½ to 190 gallons per minute. The

yield of only 7 of the 30 wells was grater than the average. In most cases, only small to moderate yields were sought and undoubtedly much greater yields could have been obtained from more adequately developed wells of larger diameter.

The coarser stratified glacial materials are the most important potential source of large supplies of ground water in Rensselaer County. Unfortunately, only a relatively small part of the County is underlain by such deposits. The more important deposits of coarse stratified materials are situated (1) in the Wynants Kill-Burden Lake kame and kettle area, (2) in the Schodack terrace, (3) in the Schaghticoke area, (4) in the Hoosic River lacustrine deposits east of North Hoosick, (5) in the deposits of glacial Lake Albany in the Hudson River Valley, and (6) in the Hudson River alluvium below Troy.

The kame and kettle area in the towns of Poestenkill and North Greenbush has an irregular polygonal shape with an area of approximately 8 square miles. It is bounded on the northwest by the town of Wynantskill, on the southwest by West Sandlake, on the southeast by Averill Park, and on the northeast by Moules Lake. The valley of the Wynants Kill between West Sandlake and Wynantskill forms its western boundary. An arm of this same area extends northward from Averill Park to Poestenkill. The surface topography is rough and uneven, and is easily recognizable by its numerous irregularly-shaped knobs, depressions, and small lakes. It is believed that a thin lobe of stagnant ice persisted in a preglacial depression long after the main part of the ice sheet had disappeared from the Hudson Valley region. Glacial till and other rock debris from the higher land to the west, south, and east were washed upon the lingering ice lobe, covering it with a layer of stratified sand and gravel. The ice subsequently melted from beneath this cover, creating a "collapsed plain". As the ice melted from beneath the cover of stratified debris, marginal lakes were created into which fine sands and clay were washed.

The present valley of the Wynants Kill from Wynantskill to West Sandlake is entrenched into what is probably the material deposited in the bed of a marginal lake. At well Re 438, 65 feet of clay and hardpan were penetrated before bedrock was encountered. The thickness of the outwash and delta deposits in the area is exceedingly variable, ranging from a few feet to over 120 feet. The thickest deposits appear to be located near the margins of the old buried ice mass. The thickest deposits so far penetrated are situated in the upper valley of the Wynants Kill, south and east of West Sandlake. For example, wells Re 433 and Re 434 each penetrated 120 feet of sand and gravel before reaching bedrock. And, wells Re 420 and Re 422 penetrated 115 feet and 74 feet of unconsolidated deposits, respectively, before reaching bedrock.

Most of the drilled wells in the Wynants Kill area pass through the beds of stratified sand and gravel and obtain water from the underlying bedrock, as only small supplies were sought. This has been done, not because of any difficulty in developing a supply in the stratified material, but because it has been determined that when only a small supply is required, the time of drilling and the cost of a well ended in bedrock are generally less than those for one screened in the stratified deposits. It is reported that the cost of a well screen and the time required to set it, and develop the surrounding material, are generally greater than the cost and time of drilling a well to bedrock.

The stratified glacial deposits are tapped by only a few wells in the Wynants Kill area. The largest development is at the Pawling Sanatorium near the village of Wynantskill, where three shallow driven wells are pumped at the average rate of about 20,000 gallons a day. The wells are 26 feet deep and have a maximum combined yield of about 80 gallons a minute. A log of the materials penetrated by one of the wells at the Sanatorium, well Re 151, is given in table 7. Well Re 318, 60 feet deep, also taps the stratified deposits. It is not equipped with a screen and draws water through the open end of the well casing and yields about 10 gallons a minute.

The stratified glacial materials in the Schodack terrace consist mainly of well-sorted beds of coarse clean sand and gravel. Lack of complete data make it difficult to determine the character and thickness of the terrace deposits. However, exposures in local gravel pits show coarse beds and lenses of cross-bedded sand and gravel. That the deposits are highly permeable is evidenced by the absence of standing water in most of the kettle holes that dot its surface. The log of the public-supply well at East Greenbush, Re 475, shows 10 feet of coarse sand below 60 feet of gravel. On the basis of this and other data, it is

estimated that the average thickness of the terrace deposits is about 100 feet, ranging from a feather edge at the inner margin at East Greenbush and Schodack Center to well over 100 feet near its center.

Although conclusive data are not available, it is believed that the deposits underlying the Schodack terrace are a potential source of considerable ground water, as the stratified beds are relatively thick and yield water freely. For example, the well of the East Greenbush Terrace Water Company, Re 475, yield water at the rate of 30 gallons per minute with a drawdown of only 5 feet. The diameter of this well is 8 inches and it is finished with only 10 feet of screen. Other wells indicate similar features and show that water may be developed at nearly all horizons in the terrace deposits. Many seepage springs issue from the edges of the terrace deposits. They are especially numerous along the western base of the terrace and are abundant at that place because bedrock lies at or just below the land surface, preventing further downward percolation. It is estimated that some of these springs flow as much as 80 gallons per minute. The Fred Lemka spring, Re 12Sp, for example, yields 50 gallons per minute (table 4). Springs of the seepage type also issue along the bases of the sloping sides of the deeper kettle holes in the terrace, and at the foot of the steep sides of the Moordener Kill Valley, where it crosses the terrace.

Judging from the abundance of springs, and the yield and specific capacity of the wells which tap the terrace deposits, it would appear that these deposits are a potential source of considerable ground water. In view of this, it is surprising that a large percentage of the wells drilled in the area have passed entirely through the stratified deposits and have been ended in bedrock, a much less satisfactory source of water. It is believed that large yields can be obtained from the terrace deposits if tapped by properly constructed and developed wells.

The beds of stratified sand and gravel lying just west of Schaghticoke have been deeply dissected by the Hoosic River. It has cut a channel through the old delta beds to bedrock and thus offers an excellent opportunity to examine the character of the Pleistocene deposits. In general, there is a layer of dark-gray till, about 40 feet thick, at the base of the section, just above bedrock. The till is overlain by about 100 feet of fine stratified material, chiefly fine clayey sand. In turn, this material is overlain by more than 200 feet of coarse sand and gravel. One mile below Schaghticoke there is a total thickness of about 260 feet of sediments overlying the bedrock in the gorge of the Hoosic River. However, wells Re 26 and Re 73, situated nearer to the head of the old delta, encountered rock at only 70 and 98 feet below land surface, respectively.

The structure of the stratified materials at the mouth of the Hoosic River does not appear to be favorable for the storing of large supplies of water. The thick deposit of fine sand and clay below the coarse surficial beds tends to limit downward percolation of ground water, causing it to discharge at many springs along the valley walls of the Hoosic River. Because of this, the water table lies at relatively great depths below the land surface. At well Re 73, for example, it is reported to be about 80 feet below land surface. Several drilled wells in the vicinity of Schaghticoke have passed through the entire thickness of the unconsolidated deposits without encountering any noticeable amount of water, and all drilled wells in the area obtain water from bedrock.

The unconsolidated materials in the valley of the Hoosic River between North Hoosick and the Massachusetts boundary are believed to consist essentially of fine-grained materials. Well records indicate bedrock is overlain in most places by only blue and white clay. Few data have been obtained that would indicate the range in thickness of these materials. However, well Re 95, near the side of the valley, penetrated 88 feet of white clay before reaching bedrock, and well Re 94, closer to the center of the present channel of the Hoosic River, penetrated 121 feet of blue clay underlain by 5 feet of gravel, in which it is ended. Other wells, such as well Re 203 in the village of Hoosick Falls and well Re 269 in the center of the present valley above North Petersburg, encountered somewhat similar conditions. Locally, however, there are excellent water-bearing sands and gravels interbedded with or lying above the clays. These coarse beds were probably laid down as outwash or as delta deposits of smaller tributary streams entering the glacial lake in which the clays were deposited. For example, the terrace along State Highway 22 between North Hoosick and Hoosick Falls is composed of such coarse deposits and exposures of coarse stratified gravels are visible in a gravel bank on the east side of the Hoosic River, about one mile

north of Hoosick Falls. Well Re 106 was drilled into this deposit and the log (table 7) shows 79 feet of sand, gravel and clay, underlying a bed of clay 103 feet thick. This well is reported to yield about 17 gallons per minute.

The municipal water supply for the village of Hoosick Falls is withdrawn from a bed of coarse gravel situated along the Hoosic River. Its source consists of four dug wells, 12 feet in diameter, having a maximum capacity of 1,300,000 gallons per day. A more complete description of this supply system is given under the section on Public Water Supplies in this report. Another deposit of coarse sand and gravel is situated in the vicinity of the village of Hoosick. Several wells in that area indicate favorable conditions. One of these, well Re 104, passed through 64 feet of unconsolidated material before penetrating bedrock. Another, well Re 103, a driven well 12 feet deep which taps the gravel, has a yield of 20 gallons per minute. On the basis of available records, it would appear that additional large supplies of water could be pumped from the more or less discontinuous beds of coarse water-bearing materials lying along the valley of the Hoosic River. In most cases, the Hoosic River flows over a part of each deposit. Thus, water pumped from wells would be replenished by inflow from the Hoosic River.

The silt and clay laid down in glacial Lake Albany deposits, because of their fine-grained character, are very poor water-bearing formations. Most of the wells in areas underlain by Lake Albany deposits obtain water from bedrock, and a high percentage of these yield less than 1 gallon per minute. It is believed that the thick blanket of lake clays limits the downward percolation of precipitation and most of that part of the precipitation not consumed by plants or dissipated by evaporation, is carried off by streams flowing in the deep transverse gullies that cut through the layers of clay. In addition, the drainage afforded by these deep ravines tends to keep the water table at a very low stage.

Nevertheless, several satisfactory domestic wells have been developed in coarser-grained layers immediately overlying the bedrock along the eastward margin of the lake deposits, particularly along State Highway 40 east of the City of Rensselaer. In this area, several wells, such as Re 150, Re 490, and Re 543, encountered thin layers of sand lying on bedrock and beneath relatively thick deposits of clay. Yields of more than 10 gallons a minute have been obtained from such wells but only after careful development.

Available well logs and records show that the channel filling of the Hudson River consists chiefly of clay and silt, locally interstratified with lenses of sand and gravel. The lenses of coarser material are potential sources of moderate supplies of ground water, but their character, extent, and thickness vary widely and must first be determined by the drilling of test wells. One well, Re 528, known to obtain water from interstratified coarse material, is at the plant of the Bayer Chemical Company situated one mile south of Rensselaer. This well is 37 feet deep and is finished with a screen set in an envelope of gravel. It is reported to yield 115 gallons per minute, with a drawdown of 22 feet after 96 hours of pumping, giving a specific capacity of 5.23 gallons per minute per foot of drawdown. A log of the material encountered in well Re 528 is given in table 7.

Recent alluvium

The Recent river alluvium in Rensselaer County consists chiefly of layers and lenses of fine sand and silt of limited extent, and thickness and, therefore, with the exception of the deposits in the inner valley of the Hudson River, is not an important potential source of ground water.

FLUCTUATIONS OF THE WATER TABLE

The water table represents the upper limit of the zone of saturation, below which the voids and other openings in all rocks are completely saturated with water under hydrostatic pressure. It is an undulating surface that generally follows in subdued fashion the rise and fall of the land surface, being closer to the land surface in the valleys than in the uplands. The water table does not remain static but fluctuates much like the water level of a surface reservoir. It rises when the amount of recharge to the ground-water reservoir exceeds discharge and declines when discharge from the ground-water reservoir exceeds the amount of recharge. The amount of rainfall or snowmelt that penetrates the soil and descends to the zone of saturation is the principal factor that controls the rise of the water table. Dis-

charge from wells, from seeps and springs, and through evaporation and transpiration are the principal factors that cause a water table to decline. The fluctuation of the water table can be readily observed in wells, and may furnish valuable information in connection with studies of the amount of ground water available, the relation of precipitation to the recharge of ground water reservoirs, the determination of whether a permanent and progressive decline of the water table is taking place, the effects of land drainage projects on the water table, and the effects of soil-erosion control methods on the water table. In Rensselaer County, the U. S. Geological Survey is obtaining periodic measurements of the fluctuation of the water table at an observation well, Re 660, situated about 3 miles east of Defreestville. Well Re 660 is a relatively shallow dug well of large diameter that taps Pleistocene till.

Observations of water level in this well were begun in April 1946. A hydrograph showing the fluctuation of the water level in well Re 660 is given in figure 3, along with a graph of the monthly precipitation at Albany, New York. Very little ground water is withdrawn in the vicinity of this well and the fluctuation of water level in it results chiefly from changes in the rate of precipitation, plant use, and natural discharge into nearby streams.

RECOVERY

Types of wells[15].

Meinzer[16] has defined a well as "an artificial excavation" that derives some fluid from the interstices of the rocks or soil that it penetrates, except that the term is not applied to ditches or tunnels that lead ground water to the surface by gravity.

Well construction is probably one of the oldest trades or arts known to man. The history of its development may be traced from the primitive activities of the Egyptians, 5,000 years ago, up through the developments and improvements introduced by early Chinese engineers to the early well-construction work performed in Europe and the United States. The majority of wells constructed in the United States, up to and for some years after the Civil War, were dug wells cased with brick or stone or any other material that would prevent the excavation from caving in. Settlement of the Middle West, however, created an early need for additional water supplies as the creeks and ponds that were first used by the pioneers became overtaxed. The drilled well thus came into common use as a relatively inexpensive means of obtaining water in a short length of time.

Wells are commonly classified by types according to the particular method of construction that is used. Thus five general types are recognized; namely, *dug, bored, jetted, driven,* and *drilled.* Each has particular advantages that make it more desirable than the others under certain local conditions. The type names themselves suggest the type of construction used to build the wells. The first four types of wells are usually put down to relatively shallow depths (less than 50 feet) and are often constructed with hand tools. The fifth type, covering drilled wells, is probably the most important type of well in use today.

Briefly, a dug well, as the name implies, is usually excavated with hand tools and lined with brick, stone, steel, wood cribbing, tile, or other suitable material. The diameter is seldom less than 3 feet and may be as great as 80 feet or more depending upon the yield that is desired and the rate at which the water-bearing strata will yield water.

A bored well is constructed with an earth auger, of either the hand or power operated type, and cased with standard well casing. It is used where speed of construction and economy of material are essential and where relatively small quantities of water are available at shallow depths in such unconsolidated formations as glacial till or alluvial valley deposits. The diameter of a bored well is not great, since it is limited by the diameter of the auger that can be used.

A jetted well is constructed where no rocks or boulders are present. It is particularly adapted to localities where water occurs in sand at shallow depths. It is a simple and dependable type of well that can be constructed rapidly with hand tools without recourse to bulky power tools. The basic method of construction involves "washing" a casing vertically into the ground until it has reached a point below the water table. The well pipe, with a

[15]. In assembling data for this section frequent reference was made to War Department Technical Manual TM 5-297, Well Drilling, Nov. 29, 1943.
[16]. Meinzer, O. E., Outline of Ground-Water Hydrology: Water Supply Paper 494, p. 60, 1923.

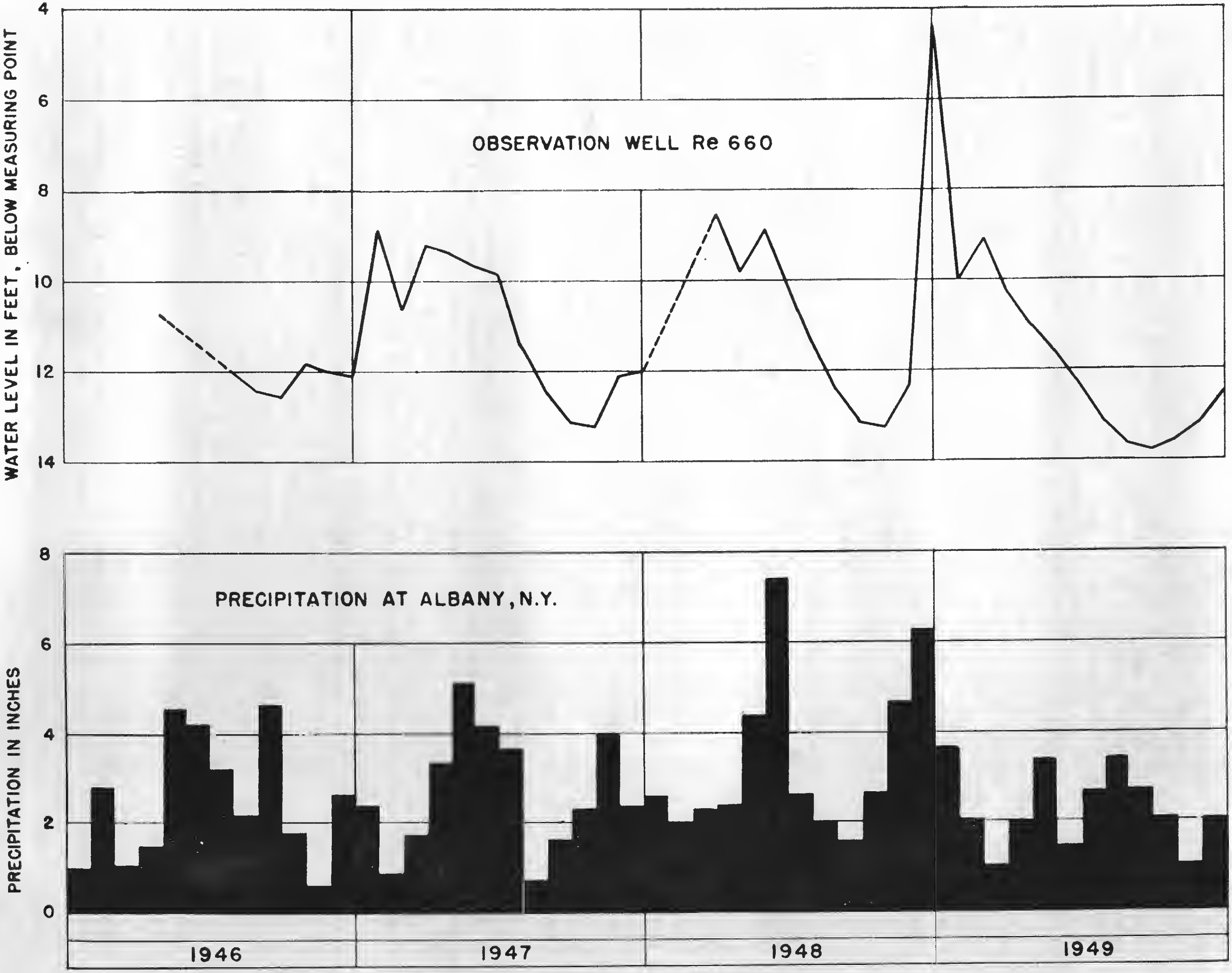

Figure 3.—Hydrograph of observation well Re 660 and the monthly precipitation at Albany, N. Y.

suitable screen attached, is then lowered into the casing and the casing is pulled leaving the well pipe and screen in the ground in position for pumping.

A driven well is adapted to localities where no rock is present and where the water-bearing material will yield at least moderate supplies of water. As the name suggests, it is constructed by driving a pointed screen called a "drive point", attached to sufficient length of pipe, into the water-bearing formation.

Drilled wells, as previously indicated, constitute the most important and most widely used type or class of wells. The two principal methods of drilling are the percussion tool, or spudding method, and the hydraulic rotary method. Each method has its own appropriate use under certain kinds of conditions. The percussion or cable-tool method involves construction of a hole by the percussion and cutting action of a club-like, chisel-edge drilling bit that is alternately raised and dropped. The formation through which the hole is being drilled is thus broken into small fragments that become churned and mixed into a sludge. At intervals the sludge is removed from the hole with either a bailer or a sand pump. In hard rock the hole usually is drilled without casing but in unconsolidated materials well casing is repeatedly driven down so that only a few feet of open drill hole extends below it.

The hydraulic-rotary method involves rotating suitable tools that cut, chip, and abrade the rock formations into small particles. Special drilling mud is pumped down the hollow rotating drill rod, out through the drill bit attached to the lower end of the pipe, and returned back up to the land surface through the annular space between the drill rod and the walls of the hole. As the mud returns to the land surface it not only carries along the drill cuttings from the hole but seals the formations that have been penetrated, thus preventing caving. Generally, the well casing is lowered and set into place in one continuous operation after the well has been drilled to the required depth.

In the foregoing paragraphs five basic types of wells have been briefly described. In recent years, however, two new types of wells have been developed that stem from one or more of the five basic types.

The gravel-wall or gravel-packed well is constructed after first drilling a hole by either the cable-tool or hydraulic-rotary method. It is most commonly constructed by using hydraulic-rotary tools and is designed for use where the water-bearing material is composed of fine-grained sand that would otherwise require exceedingly fine screen openings. Although several methods of construction are possible, they are all designed to produce an envelope of uniform-sized gravel around the well screen. This permits use of larger-sized screen openings and, consequently, the recovery of a larger amount of ground water from the formation. The gravel envelope, however, must be correctly sized and extensive enough to permit the building up, around the screen, of a graduated wall of assorted sand and gravel.

The multiple-horizontal collector type of well was developed and first used just prior to World War II. The emergency nature of the water-supply requirements for many war industries prompted the construction of this type of well, during the war years, at many sites where other types of wells would not have produced the desired yields. A multiple horizontal collector well is constructed by sinking a reinforced concrete shaft or caisson, having an inside diameter of about 15 feet, down through the water-bearing strata and sealing it at the bottom with a heavy reinforced concrete plug. Perforated screen pipes, commonly 8 inches in diameter, are then jacked out horizontally into selected portions of the water-bearing stratum or strata for distances as great as 300 feet. The number of these "radial well points" is based on the capacity of the water-bearing formation or the yield desired. Obviously this type of well is especially adapted for use at sites where the water-bearing formation consists of a thin layer (or thin layers) of sand or gravel that could only be tapped by a well creating an exceedingly low drawdown. This type of well is also adapted for use at sites adjacent to rivers or lakes which are underlain by materials which will permit infiltration of water to the radial collectors of the well.

The types of wells available and in use today, therefore, are sufficiently varied to insure successful recovery of ground water from almost any type of water-bearing formation that test-well drilling may uncover.

Well-drilling equipment and pumps.

Early development of equipment used in drilling water wells was stimulated, in the United States, primarily by experience gained in drilling to great depths for oil and gas. In recent years, however, development has been spurred by the rapidly expanding requirements of the water-supply industry itself. As the fund of general information concerning geology and the occurrence of ground water in the United States expanded, industries and municipalities probed deeper and deeper into the earth in search of satisfactory ground water supplies. In Texas, water-bearing sands have been successfully tapped at depths in excess of 4,500 feet, and on Long Island, New York, wells tap water-bearing strata at depths in excess of 1,000 feet.

In many parts of the United States a single water-bearing stratum at a given site will not furnish an adequate supply of water. This would immediately fix and perhaps drastically limit the extent to which the area could be developed were it not for the fact that by modern methods of exploratory drilling and subsequent precise placing of well casing and screens, the low individual yields of several water-bearing strata, located at different depths below the land surface, may be combined in a single well to permit more complete utilization of the total supply available at the site.

Screens in use today in sand or gravel wells represent radical departures from the early types of screens. Former designs were predicated upon the assumption that the size of individual openings should be small enough to exclude, or prevent from passing through, from 60 to 80 percent of the fine-grained materials in the water-bearing aquifer. This practice resulted in unreasonably low values for the amount of water that could be recovered from an aquifer, clearly indicating a highly inefficient type of screen. Furthermore, the efficiency often declined with use since the screen openings usually consisted merely of square openings in wire mesh or some convenient pattern of round holes in the steel casing. A single grain of sand was sufficient to clog either type of opening, thus reducing the effectiveness of the screen. Accordingly, design refinements were repeatedly made until the present-day types of screens were evolved. These screens generally have openings calculated to exclude only about 30 percent of the fine-grained materials in the aquifer. Instead of round or square holes the openings are sharp-edged slots, widening abruptly toward the inside. The advantages of this type of opening should be obvious. A single sand grain cannot clog a slot because it can make contact at only two points, and it is only necessary for a grain to pass the sharp outer edges of the slot in order to pump out with the water.

Construction of the gravel-walled type of well previously described has been made possible by the design of two general types of underreaming tools for enlarging the diameter of a drilled hole in the particular water-bearing stratum or strata selected for development. One type of tool consists primarily of a jetting device that removes the water-bearing formation by hydraulic means. The second type of tool is a mechanical reamer having blades that can be expanded to cut out the formation to the desired diameter.

Improved designs of fishing tools now assist the driller in overcoming some of the unavoidable accidents that occur in well drilling. Despite all precautions, tools are occasionally lost or jammed in a well, causing delays ranging from a few hours up to several weeks. Any devices that can be effectively employed to overcome these difficulties are therefore of considerable importance to the individual driller and to the entire water-well drilling industry

Perhaps one of the most significant developments in the well drilling industry was the motorization of drilling equipment, providing complete portability and permitting well-drilling operations to be conducted in areas that hitherto would have been either physically or economically inaccessible. As a corollary to the truck-mountings for the drill-rigs of today there has occurred a radical stream-lining of the rigs themselves with considerable elimination of unnecessary weight. Improved designs permit easier and more rapid setting up of equipment with better handling of tools and casing. Thus, the amount of footage drilled per machine-hour today is much greater than it has been in the past.

Accompanying the development of improved well-drilling supplies and equipment permitting the construction of wells in progressively deeper-lying aquifers, there has been a continual challenge to pump manufacturers to design new and more efficient types of pumps capable of bringing water to the land surface not only from shallow levels (25 feet or less) but also from levels as much as several hundred feet beyond the suction limit. Many

types and sizes of pumps are now available and space need not be taken here to describe them all. Several of the newest types, however, are worthy of consideration.

The ejector or jet pump,[17] developed for domestic and farm use, will operate satisfactorily in relatively small diameter wells and under conditions where the water level is as much as 85 feet below the land surface. The pump is simple in construction and quiet in operation, and can be installed at some distance from the well. Its operation is similar to that of two pumps working together, one discharging into the other. With the pump primed and operating, water under high pressure is re-delivered to the jet, or ejector nozzle, located at the lower (intake) end of a vertical venturi tube set in the well near the lowest known or anticipated pumping water level. As the water at high velocity leaves the jet and passes through the venturi tube a partial vacuum is created around the nozzle. Water from the well flows into this space from the suction pipe, and is caught by the fast-moving stream. The mixture is carried into the expanded end of the venturi tube where the change from velocity head to pressure head is sufficient to lift the water to an elevation within reach of the vacuum created by the centrifugal pump at the top of the well. The centrifugal pump again develops a pressure head, delivering some of the water to a storage tank or a pneumatic pressure tank, and returning the rest to the jet to repeat the cycle.

The deep-well turbine type of pump is manufactured in a variety of models ranging in capacity from as low as 30 gallons per minute to as high as 7,000 gallons per minute. This type of pump cannot be efficiently used, however, on wells smaller than 4 inches in diameter. A typical installation consists of a vertical motor at ground level, driving a vertical shaft extending down into the well below the lowest known or anticipated pumping level. This shaft drives one or more impellers operating on the same principle as a centrifugal pump. Thus water from the well passes through a short length of suction pipe, enters the center or eye of the impeller, and is moved outward and upward by centrifugal force created by the rotation of the impeller within its housing. Because of the limitation on the size and operating speed of a single impeller, however, it is often necessary to add additional impellers to develop sufficient total force or pressure to raise the water to the desired height. Turbine pumps using more than one impeller are called "multi-stage" pumps.

For wells in which the water level is more than 150 feet below the land surface, the so-called "Hi-Lift" type of pump may be desirable. This pump is designed for relatively low capacities (30 to 60 gallons per minute) and requires a minimum well diameter of 4 inches. It operates on a principle that may be likened to the displacement of a piston in a cylinder of infinite length. A typical installation consists of a vertical motor at ground level, driving a vertical shaft extending down into the well, below the lowest pumping level. This shaft drives a rotor of helical form inside a stationary housing or "stator" having a double helical form. These helices in reality are worm-threads so that the single worm-thread of the rotor may be said to mesh with the double worm-thread of the stator. As the rotor turns, therefore, water is squeezed ahead of the rolling action of the rotor along the inner surface of the stator. A pump of this type can be used to pump water from depths as great as 400 feet below the land surface.

The prospective well owner of today, therefore, can be assured not only that his well will be constructed to take advantage of the maximum amount of recoverable ground water at the site, but also that some type of pump is available to fit the particular conditions at the site and to develop the safe yield of the well.

Local drilling techniques

Pertinent to the recovery of ground water for private, municipal, and industrial use are a study of the methods employed by local drillers, the status of development of drilling techniques in the light of improved types of wells and screens, and improvements in drilling and pumping equipment. Within 50 miles of the area covered by this report there are more than 30 drilling firms known to be currently engaged in well drilling operations. The services that they are equipped to perform range from construction of small-diameter driven or jetted wells to large-diameter (50-inch) wells, and the maximum depth to which any well can be drilled is about 3,000 feet. Supplementing these general services about 10 of these drillers are equipped to install well screens and can install gravel-packed wells. One of

17. Garver, Harry L., Safe Water for the Farm: U. S. Department of Agriculture Farmer's Bull. No. 1978, September, 1946.

these drillers has coring equipment and core barrel equipment for collecting either samples of rocks or undisturbed soil samples.

A majority of all wells investigated in the area are drilled wells over 50 feet deep. Drilled wells in the area are of two general types depending upon whether they penetrate bedrock or terminate in unconsolidated materials blanketing the bedrock. Casing for a well of the former type is generally driven to rock, and an uncased hole is drilled into the rock to a depth sufficient to give the required yield of water. At some sites, however, the rock formation is so tight that the required yield of water cannot be obtained no matter how deep the well is drilled. Casing for a well terminating in an unconsolidated material may be left open where the water-bearing material consists of a coarse gravel. It may also be plugged and then either slotted or fitted with a properly designed screen where the water-bearing material consists of fine gravel or sand. Wells finished in rock, or "rock wells" as they are often popularly called, present no serious constructional difficulties to the average driller. He may drill with confidence, knowing that when he reaches bedrock he will have a solid foundation upon which to seat his casing and that the finish of the well will then be merely a matter of drilling sufficient depth of open hole in the rock. Occasionally, however, such a procedure will not result in a successful well. The joints and crevices in the bedrock may not be numerous enough or large enough to transmit the desired quantity of water to the well. With the casing firmly seated in the bedrock any possible increments to the well supply through drainage or seepage from the unconsolidated materials overlying the rock are effectively cut off. Well records indicate that often there is a thin layer of water-bearing gravel immediately overlying the rock. Thus the meager supplies of some rock wells might conceivably have been augmented by slotting or screening the casing just above the rock.

Occasionally, however, economic considerations influence or dictate the type of well that is to be drilled. For example, if the quantity and quality of the ground water in the bedrock are satisfactory it may be more economical to ignore highly productive water-bearing sands or gravels whose development would require a screened well, and drill a "rock well" requiring no finishing other than an open hole.

Wells finished in unconsolidated materials require considerably more skill and judgment on the part of the driller. Not only must the water-bearing sands and gravels present at the site be accurately located but the particular sand or gravel or combination thereof that will give the best yield must be selected. Sufficent sampling of the material in the selected aquifer must be done to permit determination of the proper-sized slots or screen openings, and considerable skill must be exercised in setting the screen at the proper level and sealing it off from undesirable waters from other levels.

Nearly all drillers in the area are equipped with cable-tool (percussion) well-drilling rigs. The few exceptions are drillers who operate light-weight portable-type rigs for installing small-diameter and relatively shallow driven or jetted wells. As noted previously, among the drillers equipped with cable-tool rigs only about 10 are equipped to install well screens and are prepared to construct gravel-packed wells. Most of the drilling in this area, therefore, has been limited either to "rock" wells or wells having an "open" finish in coarse gravel.

Methods of developing or improving yield

Development of a well has been defined[18] as the "post-drilling treatment—to establish the maximum rate of usable water yield." Local conditions may often suggest methods of accomplishing this that differ from the several standard methods commonly used in screened wells drilled to tap sand or gravel aquifers, for example, the previously mentioned possibility of increasing the yield of some rock wells by slotting the casing just above bedrock level. Wells are "developed" primarily to increase the yield at a given drawdown or to reduce the drawdown as much as possible when pumping at the designed rate.

Methods commonly used to improve the yield of a well include *surging, over-pumping, backwashing,* and *acid treatment.* With the exception of the acid treatment method they are each designed to wash the fine sand, silt, and clay from the water-bearing formation immediately surrounding the well screen and assist in the building up of a natural gravel wall

18. War Department Technical Manual TM 5-297, op. cit., p. 173.

around the screen. Thus, water will enter the well more freely and the rate of yield per foot of drawdown (specific capacity) will be increased.

Surging a well is probably one of the best methods of development under the average conditions encountered in sand and gravel aquifers. The method utilizes some form of tight-fitting plunger that is operated up and down inside the well casing from a point about 15 feet below the static water level. This action surges the water in the sand or gravel formation, loosening the finer sand or gravel grains and aiding in carrying them through the screen slots into the well where they are periodically removed either by bailing or by pumping. The well is alternately surged and bailed (or pumped) until little or no sand is pulled in through the screen. The surging method is particularly effective inasmuch as the forceful stirring of the water repeatedly disturbs the finer sand particles preventing them from bridging against each other to close the voids or openings between the larger grains or pebbles.

The over-pumped method of developing a well, ending in sand or gravel, involves pumping it at a rate that creates excessive drawdown. This rate may or may not exceed the rate at which the finished well is to be pumped depending upon the condition of the well at the time drilling was completed. The method is intended primarily to clear the well at or below the maximum rate at which it is capable of yielding water, and cannot be used effectively to build up any graded envelope of gravel around the screen. If the well clears satisfactorily, at a final rate considerably in excess of the desired rate of pumpage it is safe to assume the well will not fail in regular service. If it does not clear, or if the desired rate of pumpage cannot be reached, then some more effective means of development must be used. The method is better suited for use at sites where it is anticipated that not much sand will be pumped during the development process.

Developing a well by backwashing may be accomplished by a number of different methods, each one of which surges or agitates the water in the formation at the well, preventing "bridging" of the sand particles and removing a large portion of the finer material. If a pump is used, three different operating procedures are possible to secure the desired results. (1) The pump may be operated at its highest capacity, until maximum drawdown of the water level is obtained, wheneupon it is stopped, the water drains rapidly out of the pump column, and the well is allowed to regain its original static water level. The process is repeated until no further improvement in yield is noted. (2) The pump may be operated to obtain maximum drawdown and then stopped and started alternately at short intervals. Thus the water level in the well is held down and frequently agitated in the formation adjacent to the well by the backwash of water in the pump column. (3) The pump may be operated until water begins to discharge at the surface. The pump is then stopped and the water allowed to drain from the column. The process merely agitates the water in the formation and is repeated as many times as is necessary.

Backwashing may also be performed by pouring water into the well as rapidly as possible and then bailing vigorously with a sand pump or bailer. Where possible a more forceful method utilizes a water-tight hose or pipe connection to the top of the well permitting water from a standpipe or pressure main to be forced down in large volume and under high pressure for 2 to 5 minutes. The connection is then removed and the well bailed vigorously.

Acid treatment of a well provides a means for regaining some of the yield that has been lost owing to gradual incrustation of the well screen. All ground water is corrosive or incrusting to a certain degree depending on the amount and kinds of substances it contains in solution. Under pumping conditions, some of the salts normally held in solution in ground water may be precipitated on the well screen and on the gravel and sand grains adjacent to the screen owing to the sudden decrease in pressure as the water flows from the formation into the well. This is particularly apt to occur where the water contains carbonate or sulfate salts. If the screen is constructed of brass, bronze, or stainless steel these incrustations may be removed by introducing at the screen level a sufficient quantity of commercial hydrochloric acid or sulfuric acid to fill the screen and creates about a 10 to 25 percent solution. This is allowed to stand for 1 to 2 hours and the well is then gently surged for several minutes and allowed to stand again for 2 hours or more. Finally the well is bailed clean and pumped until all traces of the acid are removed. Depending upon the yield noted during this pumping period, the process may need to be repeated one or more times.

Other methods of improving or developing the yield of a well include dynamiting and combined surging and pumping through use of compressed air or surge blocks. "Dry ice"

may be used to stimulate surging or pressure effects through the bubbling action that occurs when it is submerged in the well. Local conditions will usually suggest, if not determine, the particular method of development that should prove most effective.

Recovery in Rensselaer County

Ground water in Rensselaer County is recovered chiefly from drilled and dug wells, driven wells and springs being used only to a small extent. Of the approximtely 700 records of wells and springs obtained for this report, about 80 percent are of drilled wells which tap bedrock or unconsolidated overburden. Drilled wells in bedrock predominate in Rensselaer County, as bedrock lies relatively close to the land surface over most of the County and much of the overburden does not readily yield water to wells. A large percentage of drilled wells are used to supply farms, which in recent years have required an increased amount of water chiefly for sanitary purposes. Dug wells comprise about 15 percent of the wells investigated. Only a few small-diameter driven wells were located. It should be recognized that the large proportion of deep drilled wells is partly influenced by the methods of field investigation. Records of deep drilled wells often constitute the principal source of information as to the geologic and ground-water conditions of an area, and a deliberate attempt is made to collect records for many drilled wells, whereas collection of records of dug wells is not stressed.

However, in the area covered by this report, the percentage of records for the several types of wells was influenced primarily by geologic conditions, and by the scope and type of industrial activity in the County.

Drilled wells in consolidated rocks: Records were obtained for about 475 wells drilled in bedrock, this being the type most successful in Rensselaer County, as the extent and thickness of gravel deposits is limited in many places. Drilling to bedrock also eliminates the necessity of setting screens or slotting the well casing. Most of the bedrock wells are 6 inches in diameter. All of the wells for which records are available were drilled by the cable-tool method, no rotary drilling having been done by drillers in Rensselaer County.

The average depth of 345 drilled wells in consolidated rocks is 128 feet, the range in depth being 18 to 639 feet. The average yield of these wells is about 5 gallons per minute but several have moderately large yields. For example, well Re 202 is reported to yield 75 gallons per minute, the largest yield for any of the rock wells that were investigated. This well ends in limestone and probably intersects sizeable solution fractures. Another similar well, Re 281, is reported to yield 40 gallons per minute. It has a diameter of 12 inches and a depth of 298 feet, and flows at the land surface at the rate of 3 gallons per minute (table 8). Most rock wells are reported to have encountered more than one set of water-bearing joints or fractures.

Drilled wells in unconsolidated deposits: Records for about 75 wells which end in outwash materials or sandy till were collected. These wells are used principally for industrial and domestic purposes and range in depth from 7 to 200 feet. They have an average yield of about 18 gallons per minute but several yield large supplies of water. Those having the largest yields are used for industrial purposes and are finished with screens, some being gravel-packed. However, wells ending in unconsolidated deposits are surprisingly few in number, the records revealing that most drilled wells that penetrate stratified sand and gravel are cased through the entire thickness of the overburden to tap the underlying rock. It is believed that the yield of many such wells could be increased considerably if they were screened in the unconsolidated deposits.

Efficient methods of increasing the intake area of such wells are given in the foregoing section on local drilling techniques. An example of the possibility of increasing the yield of wells in Rensselaer County is shown by the experience of the Fort Orange Paper Company, near Castleton-on-Hudson about 2½ miles southwest of the Schodack terrace. The logs and construction details of two of their wells are shown in figure 4. At this plant a 12-inch hole (well 2) was first drilled through the unconsolidated deposits to bedrock and a casing was set to bedrock. An 8-inch hole in bedrock was then drilled to a depth of 97 feet below land surface. The yield of the rock well was tested and found to be about 25 gallons per minute. A 6-inch well screen was then set opposite the bed of water-bearing sand and gravel lying just above bedrock and a wall of gravel was introduced around the outside of the screen. After a period of development, which included agitation and pumping, the yield of the well was

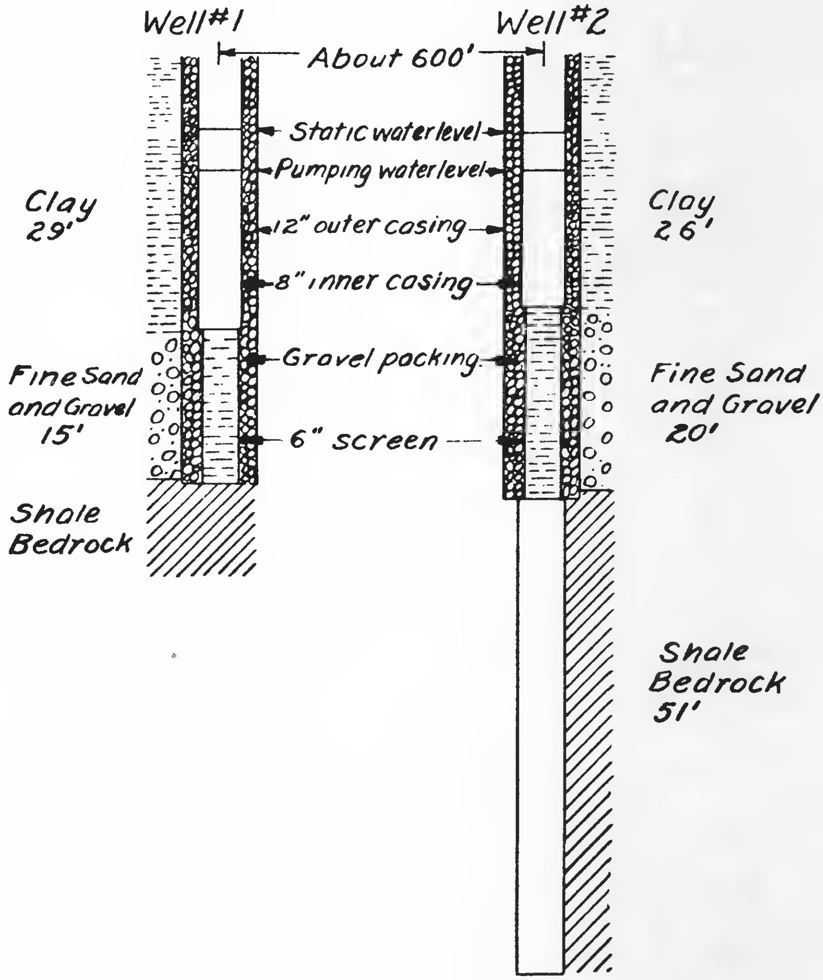

Figure 4.—Logs and construction details of two wells of the Fort Orange Paper Company, near Castleton-on-Hudson, N. Y.

increased to 190 gallons a minute, with a drawdown of 15 feet. Another similar well (well 1), having a yield of 135 gallons per minute and a drawdown of 17 feet, was then constructed.

The well records for Rensselaer reveal that some of the drilled wells that tap the unconsolidated sediments receive water only through the open end of the well casing. Thus, the amount of water that can be pumped from the well is limited by the diameter of the open end of the well pipe. Operational difficulties are sometimes encountered with this type of well as heavy pumping, which results in a large drawdown, tends to draw some of the fine materials of the stratified deposits through the open end of the well and causes damage to the pump and other parts of the distribution system. Table 3 shows the approximate intake area for different sizes and types of well casings and screens used to finish drilled wells in unconsolidated deposits and shows the advantage to be derived by using a well screen.

Table 3.—Approximate area of intake openings of open-end casings, perforated casings, and well screens.

Diameter of casing (inches)	Intake area of open-end casing (square inches)	Intake area of 5-foot length of perforated casing and well screen, closed end (square inches)		
		Casing perforated with 4-inch holes on 3-inch centers	Well screen	
			Intake area 10 percent of screen area	Intake area 20 percent of screen area
12	113	14	226	452
10	78	12	190	380
8	50	9	152	304
6	28	7	113	226
4	13	5	76	151

Dug wells: Dug wells are found chiefly in the upland rural areas and are used principally for domestic and farm supply. Most of the dug wells range from 2 to 4 feet in diameter and from 10 to 20 feet in depth. Because of the large infiltration area available, dug wells are able to extract small supplies from materials of low permeability. This factor, coupled with the large reservoir facilities offered, makes the dug well an adequate source for many homes and farms. The dug well, however, is susceptible to failure during lengthy dry periods when the water table declines below the bottom of shallow wells. In addition, this type of well generally has a casing constructed of loose stone or brick with innumerable openings that permit the inflow of polluted surface and shallow soil water. Construction of a satisfactory dug well, therefore, requires careful sealing against pollution from surface sources as well as adequate depth to assure an unfailing supply of water during drought periods.

Driven wells: Driven wells are not common in Rensselaer County owing to the prevalence of clay in the glacial materials, and those reported are situated in valley areas, particularly in the eastern part of the County, underlain by coarse gravel deposits where the water table is high. Most all of the driven wells in the County are 1¼ inches in diameter. They range in depth from 10 to 35 feet and are usually equipped with a 3-foot long screen (drive point). Such wells can be installed only in soft permeable materials and generally cannot be driven through bouldery clay, layers of hardpan, or other indurated materials. The driven well can usually be pushed to greater depths than the dug well, and thus to a certain extent it reduces the opportunity for inflow of polluted surface waters and for failure during dry periods. In addition, the cost of a driven well is relatively small. The largest yield for such a well in Rensselaer County is that of well Re 103. This well, which is 12 feet deep and 1¼ inches in diameter, yields 20 gallons per minute.

Springs: Small seepage springs are numerous in Rensselaer County and issue from openings in permeable material or from the contact of a permeable material with an underlying relatively impermeable material. Throughout the County many such springs are along the slopes of valleys and in hilly areas. The majority of the springs are of small magnitude, many ceasing to flow altogether during the dry season. The records for selected springs given in table 4 are considered representative of the largest springs in the County. Most of these are seepage springs with yields ranging from 10 to 50 gallons per minute. Several large springs of this type are in a linear belt along the western base of the Schodack terrace, approximately where the bedrock crops out at the land surface. There water moves downward through the permeable gravel and issues at the surface at the contact between the gravel and the bedrock. A belt of similar but smaller springs exists along the base of the Hoosic River delta. Here the water comes to the surface above a bed of impermeable clay or till. Most of the springs in the County are used for domestic and farm supply. However, two small public supplies obtain water from municipally-owned springs.

The largest spring in Rensselaer County, "Cold Spring", is reported to yield 1,000 gallons per minute. It is situated south of Pittstown at the base of the Rensselaer Plateau, and flows from beneath a large talus slope consisting of huge blocks of Rensselaer graywacke that have broken away from the edge of the plateau and rolled down to its base. "Cold Spring" drains a part of the plateau but the water, which forms a small brook, is not utilized.

UTILIZATION

Tabulation of the wells and springs in tables 4 and 8 shows that about 86 percent of those in use are being pumped for domestic or farm purposes. Of the remainder, 16 wells and 3 springs are utilized at industrial and commercial plants and 22 wells and 3 springs are used for public supply.

Domestic and Farm Supply

In areas not served by a public system, domestic water supplies throughout the County are obtained almost exclusively from wells and springs. The domestic uses of water include drinking, cooking, washing, and sewage disposal, and these needs are normally met by dug or drilled wells of low yield. Water for cattle and other farm animals is also obtained by the same method, and in many cases where the number of stock to be cared for is small one well may suffice for both the farm and the household. The average consumption from this type of well is generally less than 500 gallons per day.

Industrial supply

The quality of ground water withdrawn for industrial use in Rensselaer County is small and restricted mainly to pumpage by light industry such as creameries and garages. Most of the heavy industry in the County is situated in or near the larger towns and cities and utilizes municipal water supplies. Records were obtained for 6 creamery wells in Rensselaer County.

Municipal supply

Seven of the ten municipal water supplies in Rensselaer County are supplied wholly or in part by ground water, and five of these seven are supplied wholly by ground water.

Water District 1 of the Town of Berlin maintains a small supply for summer residents of the Tabortown area. Its source of supply consists of a shallow dug well situated about 15 feet from the west shore of Round Pond. Water is pumped from the well by a turbine pump having a capacity of 16 gallons per minute, and is elevated to a steel standpipe having a capacity of 11,000 gallons. The water is chlorinated and distributed by gravity. A population of about 200 is served.

The municipally-owned water supply for the town of Castleton-on-Hudson is obtained from several springs along the base of the Schodack terrace in the vicinity of Vlockie Kill. The water is impounded by an earthen-type reservoir having a capacity of 6 million gallons and is then delivered by gravity to the distribution system. A population of about 1,600 consumes an average of 150,000 gallons per day. The water is chlorinated during the summer.

Table 4.—Records of selected springs in Rensselaer County, New York.

Spring number	Location[a]	Owner	Altitude above sea level (feet)[b]	Topography	Geologic subdivision	Yield (gallons per minute)	Temperature (°F.)	Use[c]	Remarks
Re 1Sp	10Z, 12.1N, 9.0E	Walloomsac Paper Company, Inc.	500	Valley	Pleistocene gravel	..	..	Dom	Spring flows into concrete collecting basin.[d]
Re 2Sp	10Z, 8.1N, 6.6E	Lewis Watt	720	Hillside	Pleistocene till	45	..	Farm	Water piped to trough.
Re 3Sp	10Z, 4.1N, 10.8E	F. C. Paddock	600	Hillside	Rowe schist	10	..	Farm	
Re 4Sp	10Z, 0.2N, 7.5E	Town of Petersburg	900	Upland	Pleistocene till	15	..	PWS	Several springs at this location.[d]
Re 5Sp	10Z, 3.8N, 4.5E	Fred Eberhardt	1,460	Upland	Rensselaer graywacke	..	..	Dom	
Re 6Sp	10Z, 3.7N, 0.3E	"Cold Spring"	700	Upland	Rensselaer graywacke	1,000	..	..	Water forms stream at outlet.
Re 7Sp	10Z, 2.4N, 5.8W	Samuel Kelly	875	Valley	Pleistocene till	3	50	Dom	
Re 8Sp	10Y, 7.2S, 7.0E	Nelson Brookner	580	Hillside	Pleistocene till	2	..	Dom	Spring supplies 9 homes.[d]
Re 9Sp	10Y, 7.6S, 6.2E	G. E. Fellowes	400	Valley	Pleistocene sand	50	..	Ind	([d])
Re 10Sp	10Y, 6.6S, 2.8E	William Platt	300	Valley	Pleistocene sand	10	..	Ind	([d])
Re 11Sp	10Y, 9.2S, 1.5E	Hampton Manor	260	Hillside	Pleistocene gravel	12	..	PWS	([d])
Re 12Sp	10Y, 13.1S, 2.2E	Fred N. Lemka	260	Valley	Pleistocene deposits	50	54	Dom	Spring has several openings.[d]
Re 13Sp	10Y, 13.8S, 3.0E	Everett Best	300	Valley	Pleistocene deposits	10	..	Dom	([d])
Re 14Sp	10Y, 16.0S, 2.6E	Castleton Water Company	250	Valley	Pleistocene deposits	..	..	PWS	Several springs at this location.[d]
Re 15Sp	10Y, 14.8S, 2.4E	M. Krug	280	Valley	Pleistocene deposits	..	..	Dom	
Re 16Sp	10Y, 12.3S, 2.3E	Harry M. Green	280	Valley	Pleistocene deposits	40	..	Dom	
Re 17Sp	10Y, 6.7S, 7.3E	"Sand Springs"	480	Valley	Pleistocene deposits	10	..	Ind	

[a] For explanation of location symbols see section, "Purpose and Scope of the Investigation."
[b] Approximate altitude from topographic map.
[c] Dom, domestic; Ind, industrial; PWS, public water supply.
[d] For chemical analysis see Table 6.

The water supply for the village of East Greenbush is obtained partly from the City of Rensselaer which has extended its mains to the northern part of the village, and partly from a privately-owned corporation known as the Terrace Water Company. This company furnishes water to about 100 persons from a drilled well, Re 475, which taps gravel at a depth of 78 feet. This well delivers water at a rate of about 50 gallons per minute to two 1,500 gallon storage tanks. Average daily consumption is about 8,000 gallons. An analysis of the chemical content of water taken from this well is given in table 6.

Hoosick Falls, the third largest municipality in Rensselaer County, obtains its water from a group of large dug wells and an auxiliary infiltration gallery near the Hoosic River at the southern limits of the village. The dug wells are 12 feet in diameter and are cased with concrete pipe. They are interconnected and water is withdrawn by one pump. At present only three of the four wells are being operated. The infiltration gallery is located at a bend of the Hoosic River about 100 feet from its banks. It is 670 feet long, 12 feet deep, and terminates in a suction well which is pumped by 2 turbine pumps. The water is chlorinated at the pumping station, and is raised to a 470,000 gallon storage reservoir from which it flows by gravity to the distribution system. Average daily consumption is reported to be about one million gallons, of which about 50 percent is used by local industries.

The water supply for the village of Nassau is obtained from an impounding reservoir on a small stream about 1½ miles east of the village. The water is pumped to an elevated standpipe having a capacity of 175,000 gallons and is distributed by gravity. Average consumption of the population of 670 is about 40,000 gallons per day. The village also maintains an auxiliary supply well situated in the valley of the Valatie Kill in the southern part of the town. A description of this drilled well, Re 537, is given in table 8, and a log of the materials it penetrated is in table 7. An anaylsis of the chemical content of water taken from this well is given in table 6.

Petersburg is supplied by several small upland seepage springs which discharge or are piped into a concrete reservoir situated one-half mile west of town. The capacity of the reservoir is 1,680,000 gallons and the water is distributed by gravity to about 58 homes. The average daily consumption is about 20,000 gallons. A drilled bedrock well located near the reservoir is maintained as an auxiliary supply. This well, Re 281, has a natural flow of about 3 gallons per minute. An analysis of the chemical content of a water sample taken from this well is given in table 6. Other data for the well are given in table 8.

Schaghticoke obtains its water supply from two dug wells of large diameter, and an auxiliary drilled well situated about 100 feet from the north shore of Electric Lake in the northeastern part of the village. The dug wells are 20 feet deep and are about 100 feet apart. They have a syphon connection and are pumped into a clearing basin and from there to a 75,000 gallon capacity elevated steel tank. The auxiliary drilled well, Re 24, has a natural flow of about 3 gallons per minute. The maximum daily consumption of the village is reported to be 50,000 gallons per day, with average daily consumption of 35,000 gallons. A description of this well is given in table 8, and an analysis of the water is given in table 6.

Three municipalities in the County are supplied entirely by surface water. They are Berlin, Rensselaer, and Troy. The village of Berlin, population 600, obtains it water from Kendall Pond on the Rensselaer Plateau about 1½ miles west of the village. The water is piped by gravity to a 750,000-gallon earth-concrete storage reservoir near the village from which it is distributed by gravity. About 70 percent of the population is served by the municipal system. The maximum daily consumption is 75,000 gallons. An analysis of water taken from Kendall Pond is given in table 6.

The City of Rensselaer, the second largest city in the County, is supplied at present entirely by water pumped from the Hudson River. Water is withdrawn from the river through a 20-inch intake situated 3 feet below low water level. It is raised by low-lift pumps to sedimentation tanks from which it flows by gravity over sand filters and in to a clearing basin. It is then pumped to a concrete storage reservoir, having a capacity of 5,500,000 gallons, and is distributed by gravity. The average consumption is about 3 million gallons a day. The City of Rensselaer is seeking to develop a new water supply of a daily capacity of about 4 million gallons from nearby surface-or ground-water sources. An analysis of the water from the Hudson River at Rensselaer is given in table 6.

The City of Troy, the largest municipality in the County, obtains its water from several impounding reservoirs located in the uplands to the east. The reservoir system has a storage

capacity of nearly 14 billion gallons and includes the large Tomhannock Reservoir in Pittstown, the Brunswick and Vanderheyden Reservoirs in Brunswick, and the Dunham Reservoir in Grafton. The average daily consumption is about 25 million gallons, of which about 13 percent is used by local industries. Analyses of water taken from the Troy reservoirs are given in table 6.

QUALITY

Temperature

The temperature of the water used for cooling or air-conditioning purposes is of more importance than its chemical quality. Water with consistently low temperature is preferred and in this respect ground water is superior to surface water. The temperature of surface waters responds to the local atmospheric conditions and may range from 32° F. to more than 80° F. throughout the course of a year. The temperature of ground water, however, at depths of as much as 100 feet, generally remains within a few degrees of the mean annual air temperature of the region, regardless of the season. The ground-water temperature increases with depth at the rate of about 1°F. for each 100 feet. The mean annual air temperature at Troy during the period 1826 to 1930 was 49°F., whereas temperatures listed in table 8 for 18 wells indicate an average temperature of 51°F. These wells range from 14 to 320 feet in depth and most of them tap bedrock.

The temperature of water obtained from shallow wells may be expected to vary more throughout the year than that of water obtained from deeper wells. Temperatures of water in a shallow dug well, Re 660, are given in table 5.

Table 5.—Temperature of ground water in well Re 660, New York.

Date	Temperature of ground water (°F.)	Date	Temperature of ground water (°F.)
2/12/47	43.0	3/15/47	41.0
2/15/47	41.0	3/22/47	40.5
2/22/47	40.0	3/29/47	41.0
2/27/47	40.0	4 /9/47	41.0
3/ 6/47	41.0	7/26/47	52.0
3/ 9/47	41.0	7/30/47	51.0

Well Re 660 is 4 feet in diameter and was not pumped during the period covered by the temperature observations. Thus, the temperatures observed may not represent the true temperature of the ground water. However, it is believed they indicate in a general way the range of temperature of the ground water at shallow depths.

Chemical constituents in relation to use

The general chemical quality of the ground water in Rensselaer County is shown in table 6. Analyses are given for 65 samples collected by the U. S. Geological Survey and analyzed in the laboratories of the New York State Department of Health at Albany or of the U. S. Geological Survey at Washington, D. C. Other data for these wells are given in table 8.

Table 6.—Chemical analyses of natural waters from Rensselaer County, New York.

(Analyses by New York State Department of Health unless indicated otherwise. Dissolved constituents given in parts per million)

Well or spring spring number	Depth Depth (feet)	Geological subdivision of surface source	Date of collection	Dissolved solids	Iron (Fe)	Manganese (Mn)	Bicarbonate (HCO_3)	Sulfate (SO_4)	Chloride (Cl)	Hardness (as $CaCO_3$)			Total alkalinity (as $CaCO_3$)	pH
										Total	Carbonate	Noncarbonate		
Re 4	200	Pleistocene till	2/23/46	310	0.35	0.05	280	43	2.6	170	170	0	230	8.1
Re 24	154	Pleistocene deposits	2/26/46	227	.1	1.0	244	12	5.8	190	190	0	200	7.1
Re 30	35	Pleistocene deposits	3/1/46	114	.3	.25	90	11	2.0	62	62	0	74	7.7
Re 36	170	Schodack formation	4/26/47	453	.03	.09	191	100	35	200	157	43	157	7.5
Re 39	64	Schodack formation	2/28/46	205	.03	.1	177	14	8.4	150	145	5	145	7.8
Re 68	25	Pleistocene deposits	3/5/46	505	1.0	.02	341	54	20	310	280	30	280	7.5
Re 91	67	Pleistocene deposits	2/26/46	130	1.5	.1	102	3.6	1.6	92	83	9	83	8.1
Re 94	126	Pleistocene deposits	3/9/46	225	1.0	.25	204	27	.2	172	170	2	170	7.6
Re 110	226	Stockbridge limestone	4/15/47	331	.03	.01	326	24	5.0	290	267	23	267	7.4
Re 113	224	Walloomsac slate	4/22/47	234	.03	.01	207	35	2.6	260	170	90	170	7.5
Re 146	93	Pleistocene gravel	3/13/46	149	.5	.25	150	8.5	.8	64	64	0	123	7.7
Re 149	112	Normanskill shale	3/14/46	200	1.0	.01	159	27	23	76	76	0	130	7.5
Re 175	174	Snake Hill formation	4/25/47	295	.03	.01	288	91	13	50	50	0	236	9.1
Re 178	170	Snake Hill formation	6/4/47	222	.1	.01	185	17	5.0	100	100	0	152	7.7
Re 198	221	Walloomsac slate	4/14/47	340	.05	.4	224	55	21	250	184	72	184	7.3
Re 203	98	Pleistocene deposits	3/22/48	413	2.5	.3	224	40	40	220	184	36	184	7.7
Re 204[a]	12	Pleistocene deposits	9/5/44	..	.03	..	96	..	6.0	90	79	11	79	6.8
Re 218	156	Schodack formation	4/25/47	252	.15	.08	116	30	1.0	228	95	133	95	7.5
Re 234	18	Pleistocene deposits	3/28/46	66	.1	.01	21	11	1.8	32	17	15	17	6.3
Re 279	48	Schodack formation	4/26/44	..	.08	..	29	..	.8	32	24	8	24	6.9
Re 281	298	Schodack formation	8/23/40	..	.07	..	118	..	.4	84	84	0	97	7.9
Re 285[bc]	32	Rensselaer graywacke	9/5/47	134	.38	.0	118	16	2.2	100	97	3	97	7.5
Re 288	52	Rensselaer graywacke	4/26/47	138	.25	.01	87	15	1.6	84	71	13	71	6.5
Re 301	168	Nassau formation	4/17/47	313	.03	.08	210	11	37	230	172	58	172	7.4
Re 302	92	Nassau formation	3/7/46	158	.03	.08	120	21	4.0	88	88	0	98	7.5
Re 309	14	Pleistocene gravel	4/3/46	172	.2	.01	91	16	9.0	98	75	23	75	6.7
Re 312	160	Nassau formation	12/4/46	..	.25	..	104	..	7.6	108	84	24	84	7.1
Re 328	18	Pleistocene gravel	10/24/45	..	.4	..	43	..	68	106	35	71	35	7.1
Re 334	12	Pleistocene gravel	4/8/46	29	.2	.01	15	6.5	1.2	34	12	22	12	6.8
Re 337	62	Walloomsac slate	4/30/47	105	.5	.75	80	14	1.0	74	66	8	66	7.5
Re 347	120	Rensselaer graywacke	4/30/47	60	.2	.01	59	2.6	.8	50	48	2	48	7.0
Re 352	7	Pleistocene gravel	4/11/46	104	.1	.01	43	16	3.8	60	35	25	35	6.8
Re 392	85	Schodack formation	5/23/45	..	.2	..	298	..	180	100	100	0	244	8.4

See footnotes at end of table.

Table 6.—Chemical analyses of natural waters from Rensselaer County, New York. (Concluded)

(Analyses by New York State Department of Health unless indicated otherwise. Dissolved constituents given in parts per million)

Well or spring number	Depth (feet)	Geological subdivision of surface source	Date of collection	Dissolved solids	Iron (Fe)	Manganese (Mn)	Bicarbonate (HCO_3)	Sulfate (SO_4)	Chloride (Cl)	Hardness (as $CaCO_3$) Total	Hardness (as $CaCO_3$) Carbonate	Hardness (as $CaCO_3$) Noncarbonate	Total alkalinity (as $CaCO_3$)	pH
Re 426	62	Walloomsac slate	4/23/46	417	2.0	.08	279	69	2.2	30	30	0	229	9.3
Re 438[d]	340	Schodack formation	5/13/46	..	.2	..	180	..	5.0	48	48	0	148	7.5
Re 434	174	Schodack formation	4/20/46	165	.05	.03	140	20	1.2	84	84	0	115	7.8
Re 459	63	Pleistocene sand	6/20/46	497	.1	1.5	289	55	17	290	237	63	237	7.0
Re 475	86	Pleistocene gravel	6/21/46	..	.03	..	134	..	5.0	144	110	34	110	7.8
Re 481	102	Normanskill shale	5/18/46	535	2.0	.2	256	131	7.4	300	210	90	210	7.1
Re 496	65	Pleistocene till	5/31/46	359	.1	.01	226	46	20	176	176	0	185	7.0
Re 537	34	Pleistocene deposits	5/18/38	..	.03	..	30	..	2.4	50	25	25	25	6.6
Re 555	45	Schodack formation	3/6/47	..	.1	..	120	..	60	128	98	30	98	6.0
Re 579	116	Rensselaer graywacke	5/12/47	261	.03	.08	236	32	.8	200	193	7	193	7.3
Re 592	85	Normanskill shale	3/15/46	238	1.5	1.0	183	13	13	80	80	0	150	7.3
Re 593	28	Pleistocene gravel	3/15/46	412	.1	.03	271	104	12	270	222	48	222	7.3
Re 599	156	Schodack formation	6/22/44	..	.1	..	117	..	16	104	96	8	96	7.7
Re 627	130	Schodack formation	6/5/47	153	.25	.02	83	21	3.2	94	68	26	68	7.1
Re 639	125	Schodack formation	6/5/47	197	.03	.08	155	30	3.6	104	104	0	127	7.8
Re 1Sp	..	Pleistocene till	3/7/46	118	.03	.01	61	25	5.8	74	50	24	50	6.7
Re 4Sp	..	Pleistocene till	3/9/46	45	.2	.02	24	6.8	.4	30	20	10	20	6.3
Re 8Sp	..	Pleistocene till	11/17/42	..	.5	..	20	..	2.0	32	16	16	16	7.0
Re 9Sp	..	Pleistocene deposits	5/13/46	90	.07	.01	49	20	3.0	54	40	14	40	6.6
Re 10Sp	..	Pleistocene deposits	6/10/46	183	.1	.01	121	28	4.2	116	99	17	99	7.2
Re 11Sp	..	Pleistocene deposits	8/3/45	..	.4	..	216	..	6.8	200	177	23	177	7.7
Re 12Sp	..	Pleistocene deposits	6/10/46	145	.2	.01	117	22	2.0	100	96	4	96	8.0
Re 13Sp	..	Pleistocene deposits	6/10/46	165	.03	.01	156	18	1.6	124	124	0	128	7.6
Re 14Sp	..	Pleistocene deposits	5/14/46	..	.03	..	95	..	3.2	82	78	4	78	7.6
		Babcock Lake, Grafton	8/8/44	..	.8	.	7	..	1.8	22	6	16	6	7.1
		Hudson River at Rensselaer	11/20/42	..	.7	..	54	..	5.0	48	44	4	44	7.3
		Hoosic River at Schaghticoke	7/18/24	..	..	..	104	..	3.8	94	85	9	85	..
		Round Pond, Berlin	9/30/40	..	.04	..	34	..	.6	34	28	6	28	6.3
		Town of Berlin, Kendall Pond	4/20/47	..	.4	..	11	..	.4	14	9	5	9	7.1
		City of Troy, Grafton Reservoir	7/27/45	..	.4	..	4	..	4.2	12	3	9	3	6.8
		City of Troy, Tomhannock Reservoir	7/27/45	..	.2	..	27	..	2.0	28	22	6	22	6.8
		City of Troy, Vanderheyden Reservoir	7/27/45	..	.4	..	49	..	8.0	40	40	0	40	7.1

[a] Fluoride, 0.05 P.P.M.
[b] Analysis by Quality of Water Branch, U. S. Geological Survey.
[c] Silica, 11 P.P.M.; Calcium, 32 P.P.M.; Magnesium, 4.9 P.P.M.; Sodium and Potassium, 7.9 P.P.M.; Fluoride, 0.1 P.P.M.; Nitrate, 0.5 P.P.M.
[d] Analysis obtained from the Permutit Company, New York, New York.

Dissolved solids: The dissolved solids are the residue left upon evaporation of a water sample. The residue may also contain a small quantity of organic material and a little water of crystallization. Water with less than 500 parts per million (one grain per U. S. gal. equals 17.118 p. p. m.) of dissolved solids is generally satisfactory for domestic use, except for the difficulties resulting from excessive hardness or iron content. Water with more than 1,000 parts per million is likely to contain enough of certain constituents to produce a noticeable taste or to make the water unsuitable in other respects. All the analyses of ground water in Rensselaer County show less than 1,000 parts per million of dissolved solids but two show more than 500 parts per million. Only five show less than 100 parts per million (table 6). Water obtained from unconsolidated deposits is generally somewhat lower in mineral content than that obtained from the consolidated deposits. Of the latter, the shale and slate generally yield water with the highest dissolved mineral content, and the Rensselaer graywacke, occupying the highlands to the east, yields water with the lowest dissolved mineral content.

Iron. (Fe): Iron is dissolved from many rock materials. If a water contains much more than 0.3 part per million of iron the excess may separate out when exposed to the air and settle as a reddish sediment. Iron in the water sometimes stains cooking utensils and bathroom fixtures and it is very troublesome to industries such as laundering, tanning, and paper manufacturing. Iron is found in noticeable amounts in the ground water of Rensselaer County, and nearly half of the samples analyzed show over 0.3 part per million of iron, with eight of these showing over 1.0 part per million (table 6). Wells in unconsolidated deposits generally yield water having a slightly higher iron content than do wells in consolidated rocks. The average iron content of 28 samples from wells tapping unconsolidated deposits is 0.40 part per million, whereas the average for 29 rock wells is 0.31 part per million. Waters in the Pleistocene till have the highest iron content, and those in the Rensselaer graywacke have the least.

Manganese (Mn): When present in quantities greatly exceeding 0.05 part per million, manganese causes gray to black discolorations on many of the materials it contacts. It also causes clogging deposits in pipes and is particularly troublesome in laundry and textile plants. Nineteen of the analyses showed over 0.05 part per million of manganese and three of these had over 1.0 part per million. The mean manganese content of the analyzed samples shown in table 6 is 0.17 part per million.

Chloride (Cl): Chloride is dissolved in small quantities from many rock materials and is one of the principal constituents in sea water. Sewage also may contain appreciable quantities of chloride, and a chloride content higher than normal for the region may be considered an indication of pollution. In areas such as Rensselaer County this is particularly true in the case of shallow wells because the chloride content normally increases with the depth of the well. The U. S. Public Health Service recommends 250 parts per million as a limit for chloride in potable water. No waters exceeding this limit have been reported in Rensselaer County and only one well yields water that has more than 100 parts per million of chloride. The average chloride content for the wells and springs shown in table 6 is 12 parts per million.

Sulfate (SO_4): Sulfate is dissolved in large quantities from gypsum and is formed from the oxidation of iron sulfides principally pyrite. Sulfate in small amounts has little effect on the general use of a water but magnesium sulfate and sodium sulfate may be present in sufficient quantity to give a bitter taste. Sulfate in a hard water may increase the cost of softening and will form a hard adhering scale in a steam boiler. The U. S. Public Health Service recommends 250 parts per million as the limit for sulfate in a potable water. None of the analyses for Rensselaer County exceeded this figure and the average sulfate content of waters from 38 wells shown in table 6 is 36 parts per million.

Hardness: Hardness of a water is most commonly recognized by the amount of soap required with the water to form a lather in washing. In addition to increasing the consumption of soap, the constituents that cause hardness, calcium and magnesium, are also the active agents in the formation of the greater part of all scale in steam boilers and in vessels in which water is heated or evaporated. Table 6 shows the total hardness as well as the carbonate and noncarbonate hardness of waters analyzed. Carbonate hardness, caused by the presence of calcium and magnesium bicarbonates (temporary hardness), can largely be removed by boiling the water. The noncarbonate hardness (permanent hardness), is due to

the presence of calcium and magnesium chlorides or sulfates which cannot be removed by boiling. The noncarbonate hardness generally forms a harder scale, but there is no difference between the two as far as consumption of soap is concerned. Water with a hardness of less than 50 parts per million is generally considered as soft, and softening treatment is rarely justified. Hardness between 50 and 150 parts per million does not seriously interfere with the use of water for most purposes but it does increase the consumption of soap. Accordingly, softening may be profitable for laundries or other industries that use large quantities of soap. Treatment for the prevention of scale is necessary for the successful operation of steam boilers using water with a hardness approaching 150 parts per million, Hardness in excess of 150 parts per million is noticeable to everyone, and where the hardness is 200 or 300 parts per million it is frequent practice to soften water for household use or to install cisterns to collect rain water. Where municipal water supplies are softened an attempt is generally made to reduce the hardness to about 60 parts per million. The additional improvement from further softening an entire public supply is not deemed worth the added cost.

The analyses for Rensselaer County show a wide range in total hardness, (table 6 showing a range from 30 to 310 parts per million), and 17 waters analyzed had a hardness of more than 150 parts per million. Only one shows more than 300 parts per million. The average total hardness for all the waters analyzed is 126 parts per million. In general, the consolidated deposits yield water that is harder than water from the unconsolidated deposits, but within each group there is a wide range according to locale and type of sediment involved.

Hydrogen-ion concentration (pH): The hydrogen-ion concentration of a water is expressed by the unit pH, and its importance lies in its indication of the corrosiveness of the water. The pH of a water is the negative exponent of the concentration of hydrogen-ions in grams per liter. Thus a low pH value means a high concentration of hydrogen-ions, or a high acidic value, and a high pH value indicates a low concentration of hydrogen-ions, or a low acidic value. A neutral water has a pH of 7.0. The waters analyzed from Rensselaer County show a range in pH from 6.0 to 9.3 and an average value of 7.6. The pH value should be determined immediately after the sample is collected because changes in the alkalinity of the water occur upon contact with the air. The analyses in table 6 were not made until several days after the samples were collected, and the pH reported may not be representative of the original waters as they came from the wells and springs.

SUMMARY OF GROUND WATER CONDITIONS

The primary source of ground water in Rensselaer County is the rain and snow that fall on the immediate area. There is no indication of any extensive subterranean flow of ground water into the County from adjacent areas. Ground water generally occurs throughout the County under water-table conditions. Flowing wells are not uncommon but are believed to be caused by local conditions. No extensive artesian horizons are known.

Almost without exception the consolidated rocks in the area are dense, compact, impervious rocks which yield water only from joints, bedding planes, or solution channels. Openings of this nature are difficult to anticipate and generally tend to pinch out with depth. Yields from rock wells, therefore, show a considerable range, but on the whole they are rather poor, and generally are sufficient only for domestic and general farm use. However, most rock wells are used for domestic and farm supplies, and no attempt was made in drilling them to develop the maximum yield of the rocks tapped. It appears certain, therefore, that deeper wells of larger diameter that are completely developed, would generally yield considerably more water than is indicated by the records given in table 8. The shales of the Hudson River Valley that are overlain by thick deposits of clay, generally have the smallest yield, whereas the Stockbridge limestone, which is traversed by large open joints in places enlarged by solution, generally has the greatest yield.

The unconsolidated glacial deposits constitute the most important potential source of ground water in the area. They range from unassorted till to well-sorted outwash deposits and consequently there is considerable range in yields. The till yields only small quantities of water to dug wells of large diameter and is tapped only for domestic purposes. The clay, which constitutes the finer outwash deposits, is practically impervious. The sand yields water readily to dug and driven wells. The coarser glacial deposits are the most prolific aquifers in

the County, but have been tapped by only a few wells. The quality of water obtained from the glacial deposits shows a considerable range, but on the average the water has a lower mineral content than does that obtained from rock aquifers. The unconsolidated deposits constitute the only major source from which future demands for large quantities of water can be satisfied. However, only a relatively small part of the County is underlain by deposits of this nature. These have been tapped by only a few wells, and because of this their extent and character are only partly known. It is believed, however, that large supplies can be developed from the coarser glacial deposits, particularly from those that lie in the valleys and are traversed by streams.

Ground water in Rensselaer County is recovered chiefly by means of wells. Some small springs of the gravity type are utilized primarily for domestic and farm purposes. Dug and driven wells are utilized mostly for domestic and farm purposes, whereas the drilled wells are used for the same purposes and also for industrial and public supplies. The individual industrial demand for ground water, however, is slight. Most industry is concentrated in urban areas, and consequently any large demand for water for industrial purposes has been met by the municipal supplies. The total pumpage for industrial use from privately owned wells and springs throughout the County is about 100,000 gallons per day. Seven of the ten public supplies in Rensselaer County are obtained from ground water, and the average daily consumption at these ground-water plants is about 1,300,000 gallons per day.

REFERENCES

Cook, John H., *The disappearance of the last glacial ice sheet from eastern New York*: New York State Mus. Bull. 251 pp. 158-176, 1924.

Cook, John H., *The glacial geology of the Capital District*: New York State Mus. Bull. 285, pp. 181-199, 1930.

Cushing, H. P., and Ruedemann, R., *Geology of Saratoga Springs and vicinity*: New York State Mus. Bull. 169, Feb. 1914.

Dale, T. N., *The Rensselaer grit plateau in New York*: U. S. Geol. Survey Ann. Rep't. 13, pt. 2, pp. 291-340, 1893.

Dale, T. N., *Structural details in the Green Mountain region and in eastern New York*: U. S. Geol. Survey Ann. Rep't. 16, pt. 1, pp. 543-570, 1896.

Dale, T. N., *The slate belt of eastern New York and western Vermont*: U. S. Geol. Survey Ann. Rep't. 19, pt. 3, pp. 153-300, 1899.

Dale, T. N., *Geology of the Hudson Valley between the Hoosic and the Kinderhook*: U. S. Geol. Survey Bull. 242, 1904.

Flint, R. F., *The stagnation and dissipation of the last glacial ice sheet from eastern New York*: New York State Mus. Bull. 251, Mar. 1924.

Garver, H. L., *Safe Water for the Farm*: U. S. Dept. Agr. Farmers Bull., 1978, Sept. 1946.

Goldring, Winifred, *Geology of the Coxsackie quadrangle, New York*: New York State Mus. Bull. 332, Feb. 1943.

Latimer, W. J., Diebold, C. H., Secor, Wilbur, Mead, C. P., and Howard Montague, Jr., *Soil survey of Rensselaer County, New York*: U. S. Dept. Agr., Bur. Chemistry and Soils Ser., No. 15, Mar. 1937.

Meinzer, O. E., *Outline of ground-water hydrology*: U. S. Geol. Survey Water Supply Paper 494, 1923.

Prindle, L. M., and Knopf, E. B., *Geology of the Taconic quadrangle*: Amer. Jour. Sci., 5th ser, vol. 24, pp. 257-302, 1932.

Ruedemann, R., *Geology of the Capitol District*: New York State Mus. Bull. 285, Dec. 1930.

Stoller, J. H., *Glacial geology of the Cohoes quadrangle*: New York State Mus. Bull. 215-216, Nov.-Dec. 1918.

Well drilling: War Dept. Tech. Manual TM 5-297, Nov. 29, 1943.

Woodworth, J. B., *Ancient water levels of the Champlain and Hudson Valleys*: New York State Mus. Bull. 84, 1905.

Table 7.—Logs of selected wells in Rensselaer County, New York.

Re 17; 10Z, 9.2N, 5.9W; B. Whinnery, Schaghticoke; drilled by Francis Flynn in 1945; altitude about 370 feet above mean sea level.

	Thickness (feet)	Depth (feet)
Sand	40	40
Gray clay	37	77
Shale	13	90

Re 43; 10Z, 13.0N, 5.5E; Hood Milk Co., Eagle Bridge; drilled by J. A. McQueen and Son in 1945; altitude about 390 feet above mean sea level.

	Thickness (feet)	Depth (feet)
Sand and gravel	38	38
Clay and gravel	22	60

Re 75; 10Z, 13.3N, 6.8W; Frank Quackenbush, Schaghticoke; drilled by M. Sanders in 1945; altitude about 100 feet above mean sea level.

	Thickness (feet)	Depth (feet)
Clay	40	40
Hardpan	53	93
Shale	3	96

Re 94; 10Z, 8.0N, 7.3E; Fred Strait, Hoosick Falls; drilled by J. A. McQueen and Son in 1945; altitude about 450 feet above mean sea level.

	Thickness (feet)	Depth (feet)
Blue clay	121	121
Gravel	5	126

Re 95; 10Z, 7.6N, 10.5 E; Sanford Hewitt, Hoosick Falls; drilled by J. A. McQueen and Son in 1944; altitude about 460 feet above mean sea level.

	Thickness (feet)	Depth (feet)
Top soil	30	30
White clay	58	88
Slate	14	102

Re 106; 10Z, 10.9N, 7.7E; Howard B. Thompson, North Hoosick; drilled by Stewart Bros. in 1938; altitude about 510 feet above mean sea level.

	Thickness (feet)	Depth (feet)
Sand	15	15
Clay	103	118
Gravel	6	124
Clay	42	166
Sand and gravel	31	197

Re 150; 11Z, 10.0N, 10.8W; J. Nelson Morford, Rensselaer; drilled by Hall and Co. in 1939; altitude about 240 feet above mean sea level.

	Thickness (feet)	Depth (feet)
Yellow and blue clay	55	55
Sand	2	57
Shale, at	....	57

Re 151; 11Z, 13.4N, 5.9W; Pawling Sanatorium, Wynantskill; driven wells; altitude about 500 feet above mean sea level.

	Thickness (feet)	Depth (feet)
Top soil	2	2
Gravel	30	32
Clay	45	77
Sand	3	80
Shale	12	92

Re 202; 10Z, 9.9N, 11.2E; Ralph Hall, Hoosick Falls; drilled by Olson in 1945; altitude about 640 feet above mean sea level.

	Thickness (feet)	Depth (feet)
Yellow clay	127	127
Limestone	40	167

Re 337; 11Z, 3.7N, 6.2E; W. K. Hotch, Steventown; drilled by F. Korvetzki; altitude about 880 feet above mean sea level.

	Thickness (feet)	Depth (feet)
Clay	20	20
Hardpan	28	48
Slate	14	62

Re 396; 11Z, 10.0N, 7.5W; G. W. Briscoe, West Sandlake; drilled by R. Jensen; altitude about 430 feet above mean sea level.

	Thickness (feet)	Depth (feet)
White and gray clay	58	58
Shale	92	150

Re 424; 11Z, 9.1N, 1.6W; H. G. Haskell, Sandlake; drilled by Stewart Bros. In 1939; altitude about 900 feet above mean sea level.

	Thickness (feet)	Depth (feet)
Clay and till	180	180
Rensselaer graywacke	110	290
Red shale	52	342
Gray sandstone	12	354
Red shale	24	378
Gray sandstone	22	400

Re 459; 11Z, 2.2N, 12.7W; Ft. Orange Paper Co., Castleton; drilled by Hall and Co.; altitude about 20 feet above mean sea level.

	Thickness (feet)	Depth (feet)
Clay	20	20
Sand and fine gravel	26	46
Shale	51	97

Re 475; 11Z, 6.3N, 10.6W; Terrace Water Co., East Greenbush; drilled by Wm. Shaver in 1937; altitude about 260 feet above mean sea level.

	Thickness (feet)	Depth (feet)
Clay	8	8
Gravel	60	68
Coarse sand	10	78

Re 491; 11Z, 7.3N, 11.4W; Corliss Realty Co., Rensselaer; drilled by Germantown Artesian Well Co. in 1927; altitude about 250 feet above mean sea level.

	Thickness (feet)	Depth (feet)
Clay	50	50
Sand	2	52
Shale	78	130

Re 527; 11Z, 0.4S, 0.8W; K. Light, Brainard; drilled by Germantown Artesian Well Co. in 1927; altitude about 560 feet above mean sea level.

	Thickness (feet)	Depth (feet)
Clay	28	28
Shale	12	40
Graywacke	30	70

Re 528. Bayer Chemical Company, Rensselaer. Drilled by Kelley Well Co., in 1930. Altitude about 10 feet above mean sea level. Driller's log.

	Thickness (feet)	Depth (feet)
Clay	10	10
Sand	27	37
Clay, at	—	37

Re 529. Huyck and Sons Mills, Rensselaer. Drilled by Germantown Artesian Well Co. in 1925. Altitude about 10 feet above sea level. Driller's log.

	Thickness (feet)	Depth (feet)
Clay	36	36
Gravel	9	45
Shale, at	—	45

Table 7.—Logs of selected wells in Rensselaer County, New York. (Concluded)

Re 531; 11Z, 2.5N, 12.2W; Louis W. Hoffman, Castleton; drilled by Hall and Co. in 1937; altitude about 150 feet above mean sea level.

	Thickness (feet)	Depth (feet)
Clay	100	100
Sand	24	124
Shale	86	210

Re 536; 11Z, 1.1N, 10.5W; Herman Dederick, So. Schodack; drilled by Hall and Co. in 1942; altitude about 260 feet above mean sea level.

	Thickness (feet)	Depth (feet)
Clay	3	3
Shale	19	22
Limestone	41	63
Shale	38	101

Re 537; 11Z, 1.0N, 6.0W; Village of Nassau; drilled by Hall and Co. in 1938; altitude about 400 feet above mean sea level.

	Thickness (feet)	Depth (feet)
Gravel	18	18
Sand	9	27
Clay	7	34

Re 650; 11Z, 1.4S, 10.7W; Alonzo Park, Schodack Landing; drilled by Wm. Shaver in 1945; altitude about 230 feet above mean sea level.

	Thickness (feet)	Depth (feet)
Yellow soil	8	8
Blue clay	81	89
Coarse gravel	3	92

Table 8.—Records of selected wells in Rensselaer County, New York

Well number	Location[a]	Owner	Altitude above sea level (feet)[b]	Type of well[c]	Depth (feet)	Diameter (inches)	Depth to bedrock (feet)	Geologic subdivision	Water level below land surface (feet)[d]	Method of lift[e]	Yield (gallons per minute)	Temperature (°F.)	Use[f]	Remarks
Re 1	10Z, 6.3N, 6.5W	Arnold Nible	360	Drl	77	6	3	Normanskill shale	10	Suction	6	..	Dom	
Re 2	10Z, 6.0N, 6.4W	Margaret Carney	420	Drl	76	6	..	Pleistocene till	+20	..	..	..	Dom	Well flows.
Re 3	10Z, 5.9N, 6.6W	Frank J. Morgan	360	Drl	160	6	..	Pleistocene till	+50	None	..	..	Farm	Well flows. Water has hydrogen sulfide odor.
Re 4	10Z, 5.7N, 6.5W	Sven Anderson	330	Drl	200	6	..	Pleistocene till	..	..	5	..	Dom	Well flows 15 gallons per hour.[g]
Re 5	10Z, 7.7N, 6.2W	John Bates	400	Drl	350	8	21	Normanskill shale	20	..	4	..	Farm	
Re 6	10Z, 3.8N, 6.8W	E. C. Dusenberry	500	Drl	104	6	66	Normanskill shale	..	Force	6	..	Dom	
Re 7	10Z, 1.6N, 7.3W	Brunswick School	440	Drl	68	6	30	Normanskill shale	3	Suction	..	51	Dom	
Re 8	10Z, 1.4N, 7.0W	Milton Barber	540	Drl	70	6	18	Normanskill shale	..	Jet	15	..	Dom	
Re 9	10Z, 2.1N, 6.8W	M. Berry	860	Drl	195	6	90	Normanskill shale	50	Force	10	..	Dom	
Re 10	10Z, 2.4N, 7.9W	Joseph Tully	300	Drl	162	6	130	Schodack formation	..	..	3	..	Dom	Well flows 1 gallon per minute.
Re 11	10Z, 12.0N, 1.1W	Howard Herrington	350	Drl	220	6	145	Normanskill shale	..	..	4	..	Dom	
Re 12	10Z, 12.1N, 2.9W	Mitchell Caswell	540	Drl	100	6	16	Schodack formation	10	Force	..	..	Dom	
Re 13	10Z, 11.9N, 1.8W	William Gage	440	Drl	162	6	20	Normanskill shale	12	Jet	10	52	Farm	Well reported to flow when drilled in 1940.
Re 14	10Z, 12.8N, 2.2W	William Dorr	500	Drl	125	6	40	Schodack formation	35	Jet	6	..	Farm	
Re 16	10Z, 11.2N, 0.7W	James Simpson	400	Drl	62	6	..	Pleistocene till	35	Jet	14	..	Dom	
Re 17	10Z, 9.1N, 5.9W	Bert Whinnery	360	Drl	90	6	77	Normanskill shale	22	..	5	..	Dom	([h])
Re 18	10Z, 9.0N, 5.4W	Laura Peterson	380	Drl	93	6	40	Normanskill shale	..	Suction	1½	..	Dom	
Re 19	10Z, 8.0N, 6.9W	E. C. Sherman	320	Drl	150	6	100	Snake Hill formation	..	Force	6	..	Dom	Water has hydrogen sulfide odor.
Re 20	10Z, 3.4N, 7.2W	Joseph Tully	410	Drl	130	8	61	Schodack formation	28	Force	12	..	Dom	
Re 21	10Z, 7.2N, 6.6W	Julia Malm	320	Drl	111	6	..	Pleistocene till	20	Jet	3	..	Farm	
Re 23	10Z, 4.2N, 7.0W	Elbert Reed	430	Drl	200	6	50	Normanskill shale	70	..	5	..	Farm	
Re 24	10Z, 10.5N, 4.2W	Town of Schaghticoke	270	Drl	154	8	..	Pleistocene gravel	..	Centrifugal	3	..	PWS	Well flows.[g]
Re 26	10Z, 10.8N, 4.7W	Rensselaer Agricultural Society	388	Drl	321	6	70	Normanskill shale	35	Force	10	..	Com	Water has hydrogen sulfide odor.
Re 27	10Z, 5.1N, 6.8W	Joseph Rodriguez	400	Drl	92	6	0	Normanskill shale	..	Centrifugal	..	..	Dom	
Re 28	10Z, 1.2N, 0.9W	Chester Ellett	1,000	Drl	88	6	23	Rensselaer graywacke	13	Suction	3½	..	Dom	
Re 30	10Z, 0.1N, 3.8W	J. Yacevich	530	Drv	35	1½	..	Pleistocene gravel	..	Suction	..	..	Dom	([g])
Re 32	10Z, 0.9N, 5.1W	Edward Prout	575	Drl	136	6	20	Schodack formation	17	..	10	..	Dom	
Re 33	10Z, 2.2N, 4.1W	Myron Rose	620	Drl	139	6	15	Schodack formation	12	Jet	7	..	Farm	

See footnotes at end of table.

Table 8.—Records of selected wells in Rensselaer County, New York (Continued)

Well number	Location[a]	Owner	Altitude above sea level (feet)[b]	Type of well[c]	Depth (feet)	Diameter (inches)	Depth to bedrock (feet)	Geologic subdivision	Water level below land surface (feet)[d]	Method of lift[e]	Yield (gallons per minute)	Temperature (°F.)	Use[f]	Remarks
Re 34	10Z, 1.3N, 4.2W	Matthew Flatley	700	Drl	100	6	4	Schodack formation	7	Jet	6	..	Farm	
Re 35	10Z, 2.8N, 3.7W	J. T. Kreiger	610	Drl	108	6	8	Schodack formation	6	Jet	6	..	Dom	
Re 36	10Z, 0.5N, 5.7W	Howard Wagar	560	Drl	170	6	37	Schodack formation	8	..	7	..	Dom	(g)
Re 37	10Z, 0.4N, 6.1W	H. V. Hayner	560	Drl	150	6	14	Schodack formation	..	Force	6	..	Dom	
Re 39	10Z, 14.2N, 3.3E	Edward C. Brownell	360	Drl	64	6	14	Schodack formation	16	..	3	..	Dom	(g)
Re 42	10Z, 14.4N, 3.4E	Gold Medal Farms	360	Dug	14	180	..	Pleistocene gravel	9	Suction	50	51	Ind	
Re 43	10Z, 13.9N, 5.5E	Hood Milk Company	390	Drl	38	8	..	Pleistocene gravel	14	Suction	60	46	Ind	Well finished with 12 feet of 8-inch screen with size of openings ranging up to ¼ inch.[b]
Re 44	10Z, 14.2N, 4.2E	Darwin Sherman	380	Drl	60	6	17	Schodack formation	17	..	1	..	Dom	
Re 45	10Z, 14.0N, 5.3E	Hallie Sales	410	Drl	47	6	14	Schodack formation	4	Jet	¾	..	Dom	
Re 46	10Z, 10.9N, 3.2W	James Harrington	360	Drl	95	6	20	Schodack formation	..	..	2	..	Dom	
Re 48	10Z, 10.2N, 3.6W	Harry Cymbalak	370	Drl	60	6	30	Schodack formation	12	..	3½	..	Dom	
Re 49	10Z, 13.8N, 2.9E	M. Bisnett	430	Drl	80	6	32	Schodack formation	..	Jet	2½	..	Dom	
Re 50	10Z, 9.5N, 9.0W	Robert McMurray	60	Drl	72	6	10	Snake Hill formation	2	Jet	..	..	Dom	
Re 52	10Z, 9.8N, 9.2W	John Heron	80	Drl	165	6	22	Snake Hill formation	15	Force	..	..	Dom	Water has hydrogen sulfide odor.
Re 55	10Z, 5.8N, 8.5W	L. W. Millard	40	Drl	49	6	20	Snake Hill formation	..	Suction	..	..	Dom	
Re 56	10Z, 5.1N, 7.7W	Sylvester Turner	220	Drl	639	6	162	Snake Hill formation	..	None	1	..	None	Water has hydrogen sulfide odor.
Re 58	10Z, 7.9N, 8.2W	Thomas Bunk	210	Drl	215	6	136	Snake Hill formation	70	Suction	4	..	Dom	
Re 60	10Z, 6.3N, 7.9W	J. T. Riley	200	Dug	47	48	..	Pleistocene gravel	..	Suction	..	..	Farm	Well flows.
Re 61	10Z, 5.6N, 7.5W	Sarah Dixon	220	Drl	504	6	100	Snake Hill formation	100	Force	¾	..	Dom	
Re 63	10Z, 8.5N, 5.9W	George Kupiec	430	Drl	265	6	0	Normanskill shale	40	Force	15	..	Dom	
Re 65	10Z, 10.7N, 9.3W	Harry Albro	70	Drl	118	6	18	Snake Hill formation	45	..	3	..	Dom	Water has hydrogen sulfide odor.
Re 68	10Z, 12.3N, 5.6W	Leland Verbeck	300	Dug	25	36	..	Pleistocene gravel	..	Suction	..	..	Farm	(g)
Re 71	10Z, 11.9N, 4.3W	William H. Lapp	540	Drl	84	6	75	Normanskill shale	25	Jet	6	..	Dom	
Re 73	10Z, 10.8N, 5.2W	John L. Bacon	390	Drl	151	6	98	Normanskill shale	80	Jet	4	..	Dom	
Re 75	10Z, 13.3N, 6.8W	Frank Quackenbush	100	Drl	93	6	..	Pleistocene gravel	32	Force	5	..	Farm	(h)
Re 82	10Z, 4.3N, 0.4W	Charles Cushman	555	Drl	116	6	70	Nassau formation	18	Jet	6	..	Dom	
Re 83	10Z, 3.9N, 2.6W	John T. Smith	580	Drl	58	6	32	Schodack formation	1	Suction	½	..	Dom	

See footnotes at end of table.

Table 8.—Records of selected wells in Rensselaer County, New York (Continued)

Well number	Location[a]	Owner	Altitude above sea level (feet)[b]	Type of well[c]	Depth (feet)	Diameter (inches)	Depth to bedrock (feet)	Geologic subdivision	Water level below land surface (feet)[d]	Method of lift[e]	Yield (gallons per minute)	Temperature (°F.)	Use[f]	Remarks
Re 84	10Z, 4.4N, 1.9W	Howard Tate	580	Drl	131	6	9	Schodack formation	15	Suction	4	..	Dom	
Re 87	10Z, 3.8N, 3.2W	Ernest Rowland	560	Drl	210	6	95	Schodack formation	10	..	7	..	Farm	
Re 88	10Z, 3.3N, 4.5W	Fred W. Myer	500	Drl	50	6	6	Schodack formation	7	Jet	3	..	Dom	
Re 89	10Z, 4.8N, 1.5W	Herbert Olsen	400	Drl	76	6	7	Schodack formation	14	Jet	4	..	Dom	
Re 90	10Z, 3.9N, 4.9W	Bernice N. Ryan	445	Drl	85	6	21	Normanskill shale	..	Jet	6	..	Farm	
Re 91	10Z, 11.4N, 0.8W	Jesse Frisbie	400	Drl	67	6	24	Normanskill shale	17	Suction	..	..	Farm	(g)
Re 94	10Z, 9.0N, 7.3E	Fred Strait	440	Drl	126	6	..	Pleistocene gravel	20	Jet	26	..	Dom	(g) (h)
Re 95	10Z, 7.6N, 7.4E	Sanford Hewitt	440	Drl	102	6	88	Walloomsac slate	20	Jet	7	..	Farm	(h)
Re 98	10Z, 8.6N, 8.0E	George A. Leonard	600	Drl	177	6	30	Walloomsac slate	13	Force	3	..	Farm	
Re 101	10Z, 13.4N, 0.5E	Steven Dumal	500	Drl	70	6	20	Schodack formation	4	Jet	7	..	Farm	
Re 102	10Z, 8.0N, 8.8E	Episcopal Rectory	500	Drl	312	6	32	Walloomsac slate	23	Force	6	..	Dom	
Re 103	10Z, 7.9N, 8.5E	Charles Brown	450	Drv	12	1½	..	Pleistocene gravel	6	Suction	20	..	Ind	
Re 106	10Z, 11.8N, 7.7E	Howard Thompson	510	Drl	197	8	197	Pleistocene gravel	23	Force	16	..	Dom	Drawdown reported to be 77 feet after pumping at the rate of 5 gallons per minute for 5 hours.[h]
Re 107	10Z, 13.4N, 11.3E	Frank Somerville	580	Drl	118	6	10	Walloomsac slate	10	Suction	..	..	Dom	
Re 109	10Z, 12.2N, 8.0E	White Flo-Matic Company	430	Drl	200	6	80	Walloomsac slate	6	Jet	5	..	Ind	
Re 110	10Z, 12.6N, 7.8E	North Hoosick School	440	Drl	226	6	9½	Stockbridge limestone	33	Jet	30	..	Dom	(g)
Re 111	10Z, 12.9N, 6.8E	William Wolfram	400	Drl	94	6	..	Pleistocene gravel	65	Jet	8	..	Farm	
Re 112	10Z, 11.5N, 8.7E	Thomas O'Malley	780	Dug	6	36	..	Pleistocene till	..	Suction	..	..	Farm	
Re 113	10Z, 12.7N, 8.1E	Harry McGrath	600	Drl	224	8	40	Walloomsac slate	..	Force	3	..	Dom	(g)
Re 115	10Y, 1.0S, 7.7E	E. M. Duncan	420	Drl	240	6	108	Schodack formation	75	Force	4	..	Dom	
Re 119	10Y, 1.5S, 7.4E	Howard Winnie	400	Drl	205	8	8	Schodack formation	8	Force	1	50	Ind	
Re 120	10Y, 1.4S, 7.5E	Harry Bovee	360	Drl	133	6	32	Schodack formation	..	Force	3	..	Dom	
Re 125	10Y, 1.5S, 8.8E	Walt Wienger	560	Drl	175	6	10	Schodack formation	20	Force	3	..	Farm	
Re 127	10Y, 2.4S, 9.9E	Armand Renaud	700	Drl	197	6	144	Nassau formation	68	Force	1½	..	Dom	
Re 129	10Y, 1.1S, 9.7E	First Presbyterian Church	520	Drl	120	6	31	Nassau formation	30	Force	4	..	Dom	
Re 130	10Y, 1.4S, 9.9E	J. Freeman	660	Drl	320	6	80	Nassau formation	42	Force	8	50	Dom	
Re 136	10Z, 2.7N, 3.1W	George Krough	700	Drl	75	6	21	Schodack formation	10	Suction	3	..	Dom	

See footnotes at end of table.

Table 8.—Records of selected wells in Rensselaer County, New York (Continued)

Well number	Location[a]	Owner	Altitude above sea level (feet)[b]	Type of well[c]	Depth (feet)	Diameter (inches)	Depth to bedrock (feet)	Geologic subdivision	Water level below land surface (feet)[d]	Method of lift[e]	Yield (gallons per minute)	Temperature (°F.)	Use[f]	Remarks
Re 137	10Z, 1.3N, 5.7W	Milo Hayner	660	Drl	120	6	..	Schodack formation	..	Force	..	..	Farm	
Re 138	10Z, 0.3N, 2.8W	Frank Bulson	700	Drl	162	6	38	Nassau formation	90	Force	..	..	Farm	
Re 140	10Z, 1.1N, 3.0W	G. H. Carragan	510	Drl	96	6	30	Schodack formation	14	Jet	3	..	Dom	
Re 141	10Z, 1.5N, 2.3W	George Lockrow	508	Drv	25	1¼	..	Pleistocene gravel	..	Suction	..	..	Dom	
Re 143	10Y, 4.3S, 9.3E	V. Hoffman	500	Drl	135	6	80	Nassau formation	28	Force	3	..	Dom	
Re 146	10Y, 4.1S, 9.5E	John Bubie	482	Drl	93	6	..	Pleistocene gravel	..	Suction	7	..	Dom	Well flows 1 gallon per minute.[g]
Re 147	10Y, 0.4S, 10.6E	Everett Goyer	700	Drl	294	6	117	Nassau formation	..	..	..	..	Dom	
Re 148	10Y, 3.0S, 8.6E	William Moody	540	Drl	95	6	45	Schodack formation	15	Force	4	..	Farm	
Re 149	10Y, 6.2S, 2.9E	Jordan Dairy	300	Drl	112	8	20	Normanskill shale	18	Force	10	..	Ind	([g])
Re 150	10Y, 7.4S, 2.1E	J. N. Morford	240	Drl	57	8	..	Pleistocene gravel	20	Suction	12	..	Dom	([h])
Re 151	10Y, 4.0S, 7.1E	Pawling Sanatorium	500	Drv	26	2	..	Pleistocene gravel	5	Centrifugal	79	..	PWS	Consists of three similar wells connected to one discharge line.[h]
Re 153	10Y, 4.0S, 8.0E	Charles Herrick	500	Drl	125	6	27	Schodack formation	10	Suction	7	..	Dom	
Re 155	10Y, 2.2S, 7.6E	Fitting Brothers	500	Drl	92	6	20	Schodack formation	18	Force	5	..	Dom	
Re 156	10Y, 3.0S, 6.7E	Wagan Dairy Company	440	Drl	90	6	..	Pleistocene gravel	12	Suction	..	50	Ind	
Re 160	10Y, 5.9S, 10.4E	Matthew Walukas	940	Dug	9	36	..	Pleistocene till	1½	Bucket	..	..	Ind	
Re 162	10Y, 4.7S, 10.8E	Edward J. Miller	800	Dug	8	48	..	Pleistocene till	6	Suction	..	..	Dom	
Re 164	10Y, 2.3S, 8.9E	Otto Knauer	460	Dug	22	48	..	Pleistocene gravel	..	Suction	..	..	Farm	
Re 166	10Z, 8.3N, 2.7W	Gilbert Yates	420	Drl	85	6	7	Schodack formation	..	..	11	..	Dom	
Re 167	10Z, 8.3N, 2.3W	Clayton Stevens	420	Drl	77	6	..	Pleistocene gravel	..	None	2	..	Dom	Well flows.
Re 168	10Z, 8.3N, 2.2W	Ruth Stevens	420	Drl	118	6	94	Schodack formation	..	Force	17	..	Dom	Well flows 2 gallons per minute.
Re 169	10Z, 7.7N, 1.7W	William Croll	540	Drl	112	6	35	Normanskill shale	8	Suction	8	..	Farm	
Re 170	10Z, 10.1N, 6.8W	Marvin Button	220	Dug	13	36	..	Recent gravel	10	Suction	..	..	Farm	
Re 172	10Z, 10.3N, 7.6W	K. Weir	100	Drv	15	1¼	..	Recent gravel	12	Suction	..	..	Dom	
Re 173	10Z, 10.7N, 7.4W	Charles Button	100	Dug	19	24	..	Recent gravel	13	Suction	..	..	Dom	
Re 175	10Z, 12.1N, 8.0W	Joseph Delano	140	Drl	174	6	23	Snake Hill formation	18	Jet	4	..	Dom	Water is turbid and has hydrogen sulfide odor.[g]
Re 176	10Z, 11.7N, 8.7W	M. Stoliaroff	100	Drl	47	6	12	Snake Hill formation	10	Jet	5	..	Dom	Water is turbid and has hydrogen sulfide odor.
Re 178	10Z, 10.1N, 8.9W	Andrew Chuba	200	Drl	170	6	20	Snake Hill formation	30	Force	2	..	Farm	Water is turbid and has hydrogen sulfide odor.[g]

See footnotes at end of table.

Table 8.—Records of selected wells in Rensselaer County, New York (Continued)

Well number	Location[a]	Owner	Altitude above sea level (feet)[b]	Type of well[c]	Depth (feet)	Diameter (inches)	Depth to bedrock (feet)	Geologic subdivision	Water level below land surface (feet)[d]	Method of lift[e]	Yield (gallons per minute)	Temperature (°F.)	Use[f]	Remarks
Re 181	10Z, 10.6N, 0.8W	Sherman Herrington	580	Drl	200	6	67	Normanskill shale	..	Force	6	48	Farm	
Re 183	10Z, 10.8N, 3.8E	W. Hoosick Baptist Church	600	Drl	64	6	20	Schodack formation	12	Suction	4	..	Dom	
Re 184	10Z, 10.5N, 3.9E	Robert Abbott	580	Drl	58	6	8	Schodack formation	10	Suction	..	..	Dom	
Re 185	10Z, 11.3N, 3.3E	Earl Sherman	540	Drl	150	6	50	Schodack formation	20	Force	3½	..	Farm	
Re 186	10Z, 12.8N, 2.2E	J. Obermier	450	Drl	118	6	81	Schodack formation	..	Suction	10	..	Farm	
Re 187	10Z, 13.3N, 3.5E	Paul Baker	440	Drl	165	6	150	Schodack formation	40	Jet	7	..	Farm	
Re 193	10Z, 10.2N, 2.3W	J. T. Lohnes	400	Dug	30	36	..	Pleistocene gravel	15	Suction	..	..	Farm	
Re 197	10Z, 10.3N, 10.2E	Vincent LeBlanc	980	Drl	201	8	73	Walloomsac slate	17	Force	1	..	Farm	
Re 198	10Z, 10.6N, 10.7E	Douglas Bateholz	900	Drl	221	6	4	Walloomsac slate	6	Force	6	..	Dom	(g)
Re 201	10Z, 11.3N, 10.9E	Ralph Rimkunas	830	Drl	163	6	11	Walloomsac slate	11	Jet	2½	..	Farm	
Re 202	10Z, 9.9N, 11.2E	Ralph Hall	650	Drl	167	6	127	Stockbridge limestone	6	Suction	75	..	Farm	(h)
Re 203	10Z, 10.6N, 7.4E	Noble & Wood Machinery Co.	410	Drl	98	8	..	Pleistocene gravel	28	Deep-well turbine	30	..	Ind	(g)
Re 204	10Z, 9.9N, 7.5E	Hoosick Falls Water Company	420	Dug	12	12	..	Pleistocene gravel	..	Deep-well turbine	1,000	..	PWS	Consists of an infiltration gallery and used as an auxiliary public supply.[g]
Re 205	10Z, 13.2N, 5.2E	Mrs. Edwin Hill	700	Drl	106	6	42	Normanskill shale	..	None	9	..	None	
Re 206	10Z, 12.0N, 4.4E	Leo Lutz	700	Drl	65	8	20	Schodack formation	..	Suction	15	..	Farm	
Re 208	10Z, 12.6N, 5.6E	Hoosick School 10	600	Drl	32	8	..	Pleistocene till	16	Suction	1	..	PWS	
Re 209	10Z, 11.6N, 4.9E	Howard Hill	700	Drl	50	6	0	Normanskill shale	..	None	16	..	None	
Re 210	10Z, 6.8N, 4.0E	Keller & Kittell	620	Drl	86	6	10	Nassau formation	1	Force	4	..	Dom	
Re 212	10Z, 10.3N, 6.9E	Hans Hansen	460	Drl	40	6	..	Pleistocene gravel	31	Suction	20	..	Dom	
Re 218	10Z, 6.2N, 2.7W	William Sherman	520	Drl	156	6	26	Schodack formation	..	Jet	..	..	Dom	(g)
Re 219	10Z, 6.0N, 2.4W	Pittstown School 10	700	Drl	100	6	..	Pleistocene till	..	Suction	..	..	PWS	
Re 223	10Z, 5.4N, 3.7W	Gregory Wandzilak	780	Drl	51	6	10	Schodack formation	29	Suction	..	..	Farm	
Re 225	10Z, 7.5N, 4.4W	Leo Schmidt	430	Drl	112	6	23	Normanskill shale	7	Jet	7	..	Dom	
Re 226	10Z, 7.6N, 4.3W	Joseph Schmidt	420	Drl	126	6	17	Normanskill shale	6	Jet	17	..	Dom	
Re 228	10Z, 10.0N, 1.2E	C. Abbott	580	Dug	25	48	..	Pleistocene till	..	Suction	..	..	Dom	
Re 229	10Z, 9.5N, 0.5E	Charles Bolander	600	Drl	80	6	14	Normanskill shale	14	Suction	3	..	Farm	
Re 230	10Z, 9.1N, 1.6E	Edward Cutler	540	Drl	182	6	38	Schodack formation	27	Force	5	..	Farm	

See footnotes at end of table.

Table 8.—Records of selected wells in Rensselaer County, New York (Continued)

Well number	Location[a]	Owner	Altitude above sea level (feet)[b]	Type of well[c]	Depth (feet)	Diameter (inches)	Depth to bedrock (feet)	Geologic subdivision	Water level below land surface (feet)[d]	Method of lift[e]	Yield (gallons per minute)	Temperature (°F.)	Use[f]	Remarks
Re 232	10Z, 8.1N, 0.7E	Stephen Agan	720	Drl	86	6	6	Schodack formation	15	Suction	7	..	Dom	
Re 234	10Z, 8.6N, 2.5E	Nathan Cottrell	580	Drv	18	1¼	..	Pleistocene gravel	15	Suction	..	..	Dom	(g)
Re 235	10Z, 9.2N, 2.9E	Charles Piritz	740	Drl	90	6	20	Schodack formation	20	Jet	10	..	Dom	
Re 236	10Z, 9.5N, 4.1E	Sidney Brownell	700	Drl	124	6	10	Schodack formation	..	Force	6	..	Dom	
Re 239	10Z, 7.2N, 0.2W	Pittstown School 6	620	Drl	124	6	45	Normanskill shale	..	Suction	..	..	PWS	
Re 240	10Z, 9.0N, 0.1W	Pittstown School 9	560	Drl	67	6	15	Normanskill shale	..	Suction	..	..	PWS	
Re 245	10Z, 8.0N, 4.0E	Clarence Eldred	900	Dug	24	48	..	Pleistocene till	17	Suction	..	..	Dom	
Re 248	10Z, 10.5N, 2.3E	Clarence Bulson	740	Dug	8	36	8	Pleistocene till	..	Suction	..	..	Dom	
Re 253	10Z, 8.1S, 7.6E	M. Goodermote	1,120	Drl	150	6	70	Walloomsac slate	21	Force	4	..	Farm	
Re 255	10Z, 8.4S, 7.1E	J. Bonesteel	800	Drl	75	6	25	Walloomsac slate	3	Suction	1	..	Dom	
Re 256	10Z, 6.1S, 6.6E	John Sweeney	800	Drl	87	6	..	Pleistocene gravel	10	Suction	10	..	Dom	
Re 257	10Z, 3.7S, 5.3E	A. M. Smith	1,780	Drl	200	6	6	Rensselaer graywacke	36	Force	..	..	Dom	
Re 258	10Z, 4.3S, 3.1E	John Denew	770	Dug	12	36	..	Pleistocene till	6	Pitcher	..	..	Dom	
Re 259	10Z, 0.8S, 4.7E	Lily A. Wolf	1,700	Drl	56	6	12	Rensselaer graywacke	..	..	..	..	Dom	
Re 260	10Z, 2.3S, 3.6E	K. B. Gordenier	1,660	Dug	10	36	..	Pleistocene gravel	5	Suction	..	..	Dom	
Re 261	10Z, 7.2S, 7.2E	A. C. Jones	1,120	Drl	128	6	20	Walloomsac slate	..	Force	..	..	Dom	
Re 262	10Z, 3.2S, 4.0E	Albert Teal	1,720	Dug	5	36	..	Pleistocene gravel	..	Suction	..	..	Dom	
Re 264	10Z, 8.2N, 9.3E	Archie Rudd	520	Drl	100	6	..	Pleistocene gravel	14	Suction	..	..	Farm	
Re 269	10Z, 5.0N, 10.1E	Albert Kyer	500	Drl	109	8	..	Pleistocene gravel	20	Jet	..	..	Farm	
Re 278	10Z, 1.1N, 8.2E	T. M. Barber	500	Drl	86	6	..	Pleistocene gravel	10	Suction	..	..	Dom	
Re 279	10Z, 0.1N, 8.0E	H. J. Moses	725	Drl	48	3	3	Schodack formation	..	..	..	..	None	(g)
Re 281	10Z, 0.3N, 7.6E	Petersburg Water Company	940	Drl	298	12	100	Schodack formation	..	Deep-well turbine	40	..	PWS	Well flows 3 gallons per minute.[g]
Re 284	10Z, 1.9N, 3.7E	Y. W. C. A.	1,580	Drl	220	6	15	Rensselaer graywacke	15	Force	1½	..	PWS	
Re 285	10Z, 1.5N, 2.9E	C. F. Lyon	1,540	Drl	82	6	14	Rensselaer graywacke	15	Force	1½	..	Dom	(g)
Re 286	10Z, 1.8N, 2.5E	Charles Elkenburgh	1,500	Drl	103	6	..	Pleistocene till	..	..	..	..	Dom	
Re 287	10Z, 1.5S, 1.8E	Troy Boys Club	1,700	Drl	85	8	0	Rensselaer graywacke	..	Force	4	..	PWS	
Re 288	10Z, 0.8S, 1.9E	Grafton School 6	1,500	Drl	52	6	14	Rensselaer graywacke	15	Suction	3	..	PWS	(g)
Re 289	10Z, 0.6N, 3.1E	Reuben Lamphere	1,425	Drl	88	6	..	Pleistocene till	..	..	..	..	Dom	

See footnotes at end of table.

Table 8.—Records of selected wells in Rensselaer County, New York (Continued)

Well number	Location[a]	Owner	Altitude above sea level (feet)[b]	Type of well[c]	Depth (feet)	Diameter (inches)	Depth to bedrock (feet)	Geologic subdivision	Water level below land surface (feet)[d]	Method of lift[e]	Yield (gallons per minute)	Temperature (°F.)	Use[f]	Remarks
Re 290	10Z, 1.4N, 1.8E	Charles Rivers	1,400	Dug	18	36	..	Pleistocene till	..	Suction	..	..	Dom	
Re 291	10Z, 1.3N, 2.8E	James Bowman	1,480	Drl	72	6	62	Rensselaer graywacke	35	Suction	3½	..	Dom	
Re 294	10Z, 3.1N, 6.3E	May Brihahn	1,480	Drl	105	6	30	Rensselaer graywacke	..	Suction	½	..	Dom	
Re 299	10Z, 6.0N, 0.7E	Leo Tracy	560	Drl	103	6	47	Nassau formation	16	Suction	6	..	Dom	
Re 300	10Z, 6.8N, 5.2E	Edith North	900	Drl	106	6	3	Nassau formation	25	Force	5	..	Dom	
Re 301	10Z, 6.6N, 2.5E	Joseph J. Sullivan	600	Drl	168	6	6	Nassau formation	9	Jet	6	..	Dom	(g)
Re 302	10Z, 6.7N, 2.2E	Pittstown School 1	600	Drl	92	6	8	Nassau formation	8	Suction	2	..	PWS	(g)
Re 303	10Z, 5.2N, 0.8E	I. Ivankantz	540	Drl	122	6	30	Nassau formation	.	Suction	4	..	Farm	Well flows.
Re 304	10Z, 1.8N, 9.4E	Holard Main	1,240	Dug	32	36	..	Pleistocene till	24	Hand	..	..	Dom	
Re 305	10Z, 5.6N, 6.4E	Arnold Kuebler	820	Drl	95	6	30	Nassau formation	..	Force	7	..	Dom	Well flows 3 gallons per hour.
Re 306	10Z, 6.4N, 6.4E	George Eldred	800	Dug	30	36	..	Pleistocene till	7	Suction	..	..	Dom	
Re 307	10Z, 1.2N, 4.6E	R. L. Johnson	1,460	Drl	80	6	10	Rensselaer graywacke	30	Suction	1/3	..	Dom	
Re 308	10Z, 6.3N, 8.9E	Boston and Maine Railroad	465	Dug	18	120	..	Pleistocene gravel	15	Suction	300	..	Ind	
Re 309	10Z, 5.2N, 8.7E	Fred Brenenstuhl	470	Drv	14	1¼	..	Pleistocene gravel	..	Suction	6	..	Dom	(g)
Re 310	10Y, 5.8S, 11.8E	N. Benderheim	1,200	Dug	15	48	..	Pleistocene till	5	Suction	..	..	Dom	
Re 312	10Y, 7.6S, 9.8E	Ben Gauch	800	Drl	160	6	40	Nassau formation	50	..	4	..	Dom	(g)
Re 313	10Y, 6.0S, 8.7E	M. J. Mangan	560	Drl	82	6	0	Nassau formation	20	Force	3	..	Dom	
Re 314	10Y, 8.5S, 9.8E	Faith Mills	670	Drl	81	6	10	Nassau formation	6	Jet.	3½	..	Ind	
Re 315	10Y, 8.0S, 10.1E	Leon Smith	790	Drl	80	6	36	Nassau formation	8	Jet	3	..	Dom	
Re 318	10Y, 7.9S, 10.6E	Averill Park Central School	770	Drl	60	8	..	Pleistocene gravel	4	Suction	10	..	PWS	
Re 319	10Y, 4.8S, 7.5E	Charles Link	600	Drl	110	6	0	Schodack formation	..	Force	4	..	Dom	
Re 323	10Y, 0.2S, 5.0E	Wallace-Bryce Beverage Co.	400	Drl	240	8	40	Schodack formation	20	..	10	..	Ind	
Re 324	10Y, 13.8S, 8.2E	Imperial Pen Company	540	Drl	275	6	35	Nassau formation	..	Force	8	..	Ind	
Re 326	10Z, 14.0S, 6.4E	Sheffield Farms Company	870	Dug	10	96	..	Pleistocene gravel	6	Suction	10	..	Ind	
Re 328	10Z, 13.8S, 6.2E	Taconic Valley Grange	900	Dug	18	36	..	Pleistocene gravel	..	Suction	..	..	Dom	(g)
Re 330	10Z, 10.9S, 6.8E	A. F. Giles	1,160	Drl	157	6	116	Walloomsac slate	58	Suction	4	..	Dom	
Re 334	10Z, 7.8S, 7.2E	Arthur Mann	1,080	Drv	12	1¼	..	Pleistocene gravel	8	Suction	3½	..	Dom	(g)
Re 335	10Z, 12.9S, 6.1E	George Carpenter	1,100	Drl	62	6	..	Pleistocene gravel	..	None	1½	..	None	

See footnotes at end of table.

Table 8.—Records of selected wells in Rensselaer County, New York (Continued)

Well number	Location[a]	Owner	Altitude above sea level (feet)[b]	Type of well[c]	Depth (feet)	Diameter (inches)	Depth to bedrock (feet)	Geologic subdivision	Water level below land surface (feet)[d]	Method of lift[e]	Yield (gallons per minute)	Temperature (°F.)	Use[f]	Remarks
Re 336	10Z, 7.1S, 1.1E	O. Egli	1,460	Dug	15	36	..	Pleistocene till	12	Suction	..	58	Dom	
Re 337	10Z, 13.8S, 5.8E	W. K. Hatch	920	Drl	62	6	48	Walloomsac slate	17	Suction	7	..	Dom	([g]) ([h])
Re 338	10Z, 8.0S, 1.8E	John Haffay	1,580	Dug	16	36	..	Pleistocene till	8	Suction	..	..	Farm	
Re 339	10Z, 7.9S, 2.8E	W. H. Momrow	1,760	Dug	22	36	..	Pleistocene till	16	..	..	..	Dom	
Re 340	10Z, 16.1S, 7.2E	Harry Wylie	920	Drl	48	6	..	Pleistocene gravel	13	Suction	10	..	Farm	
Re 341	10Z, 16.7S, 6.8E	George Pohlmann	920	Drl	200	8	109	Stockbridge limestone	..	Jet	7	..	Dom	Well flows at times.
Re 343	10Z, 14.5S, 7.9E	Delmar Ellis	1,000	Drl	165	6	..	Stockbridge limestone	..	Suction	..	..	Dom	
Re 345	10Z, 12.8S, 4.8E	H. F. Clark	1,100	Dug	18	36	..	Pleistocene gravel	15	Suction	..	..	Dom	
Re 346	10Z, 12.7S, 3.9E	Edwin Greely	1,460	Drl	165	8	10	Rensselaer graywacke	15	Force	15	..	Dom	
Re 347	10Z, 12.1S, 1.5E	Jesse F. Snow	1,420	Drl	120	8	60	Rensselaer graywacke	30	Force	15	..	Dom	([g])
Re 350	10Z, 14.0S, 5.8E	M. Burdick	880	Drl	48	6	..	Pleistocene gravel	21	Force	16	..	Dom	
Re 352	10Z, 14.5S, 5.4E	F. Smith	860	Dug	7	36	..	Pleistocene gravel	5	Jet	17	..	Farm	([g])
Re 353	10Z, 11.2S, 0.2E	4-H Club Camp	990	Drl	190	8	30	Rensselaer graywacke	..	Force	11	..	PWS	
Re 355	10Y, 10.8S, 12.2E	C. D. Boughton	800	Drl	105	6	..	Pleistocene gravel	46	Force	4	..	Dom	
Re 356	10Y, 13.9S, 12.2E	Edward Hall	760	Drl	76	6	7	Nassau formation	28	Suction	18	..	Dom	
Re 357	10Y, 10.4S, 12.0E	Karl Reide	860	Drl	120	6	29	Nassau formation	10	Jet	13	..	Dom	
Re 358	10Y, 10.5S, 12.0E	Arnold Reide	860	Drl	132	6	..	Pleistocene gravel	55	Jet	3	..	Dom	
Re 359	10Z, 16.4S, 0.8E	Leha Krasne	780	Drl	95	6	..	Pleistocene gravel	..	Suction	40	..	Farm	Well flows 10 gallons per minute. Well finished with 6 feet of 5-inch screen.
Re 360	10Z, 15.4S, 2.0E	C. D. Strauss	1,040	Dug	25	36	..	Pleistocene till	..	Suction	..	..	Dom	
Re 363	10Z, 6.4S, 4.7E	Robert Goodermate	1,770	Dug	30	36	..	Pleistocene till	8	Suction	..	..	Dom	
Re 365	10Z, 2.9S, 8.5E	Wilson Jones	1,100	Drv	20	1¼	..	Pleistocene gravel	20	Suction	..	..	Dom	
Re 367	10Z, 5.0S, 6.8E	Morris Whitney	880	Drl	156	8	38	Walloomsac slate	40	..	2	..	Dom	
Re 368	10Z, 3.5S, 6.4E	C. Williams	800	Drv	19	1¼	..	Pleistocene gravel	18	Suction	4	..	Dom	
Re 370	10Z, 1.2S, 7.1E	Wallace Griswold	700	Drv	10	1¼	..	Pleistocene gravel	8	Suction	..	..	Dom	
Re 371	10Z, 1.3S. 7.4E	Erwin Greene	800	Drv	17	1¼	..	Pleistocene gravel	17	Suction	..	..	Farm	
Re 372	10Z, 0.5S, 7.3E	James W. Wylie	800	Drl	149	6	4	Walloomsac slate	4	Suction	20	..	Dom	Well flows at times.

See footnotes at end of table.

Table 8.—Records of selected wells in Rensselaer County, New York (Continued)

Well number	Location[a]	Owner	Altitude above sea level (feet)[b]	Type of well[c]	Depth (feet)	Diameter (inches)	Depth to bedrock (feet)	Geologic subdivision	Water level below land surface (feet)[d]	Method of lift[e]	Yield (gallons per minute)	Temperature (°F.)	Use[f]	Remarks
Re 373	10Z, 5.1S, 8.4E	H. M. Kuhn	1,000	Dug	30	36	..	Pleistocene till	..	None	..	..	None	
Re 374	10Z, 4.9S, 7.8E	S. E. Vail	1,030	Drl	71	6	30	Walloomsac slate	11	Force	3	..	Dom	
Re 378	10Y, 6.5S, 2.9E	E. E. Bills	320	Drl	58	6	..	Pleistocene gravel	..	Force	4	..	Dom	Total hardness reported to be 95 parts per million; chloride 1.0 part per million.
Re 379	10Y, 5.1S, 3.4E	William O'Connor	340	Drl	117	6	35	Schodack formation	15	Force	1½	..	Dom	
Re 383	10Y, 4.0S, 3.5E	Harold Wilbur	300	Drl	30	6	..	Pleistocene gravel	5	Suction	8	..	Farm	
Re 386	10Y, 4.1S, 4.2E	J. T. Campbell	380	Drl	72	6	15	Schodack formation	..	Suction	..	..	Dom	
Re 388	10Y, 5.8S, 3.5E	North Greenbush School	380	Drl	200	10	50	Schodack formation	..	Force	..	..	PWS	
Re 392	10Y, 8.4S, 4.4E	Herman Epstein	360	Drl	85	6	50	Schodack formation	..	Suction	13	..	Dom	Well flows 8 gallons per minute.[g] hours.[h]
Re 394	10Y, 7.0S, 5.1E	Glenn Ferguson	440	Drl	107	6	20	Schodack formation	..	Suction	3	..	Farm	
Re 396	10Y, 7.5S, 5.4E	George W. Briscoe	430	Drl	150	6	58	Schodack formation	17	Suction	1	..	Dom	([h])
Re 402	10Y, 5.1S, 5.2E	J. Kruczlniaki	400	Drl	52	6	10	Schodack formation	5	Suction	2	..	Farm	
Re 404	10Y, 7.4S, 3.2E	Chester Ostrander	420	Drl	126	6	7	Schodack formation	7	Force	2	..	Farm	
Re 409	10Y, 9.4S, 5.8E	J. E. Mowry	480	Drl	87	6	6	Schodack formation	4	Jet	5	..	Dom	
Re 410	10Y, 9.5S, 7.2E	B. Motilage Sons	600	Drl	78	6	12	Schodack formation	14	Jet	1	..	Dom	
Re 411	10Y, 8.8S, 5.5E	T. Southworth	540	Drl	80	8	17	Schodack formation	28	Force	3	..	Dom	
Re 415	10Y, 16.9S, 12.7E	East Nassau Central School	570	Drl	267	6	30	Stockbridge limestone	10	Force	4	..	PWS	
Re 418	10Y, 9.3S, 9.2E	George Dunworth	600	Drl	28	6	14	Nassau formation	20	Suction	1	..	Dom	
Re 419	10Y, 9.5S, 11.5E	A. E. Smith	700	Drl	117	6	30	Nassau formation	20	Jet	2	..	Dom	
Re 420	10Y, 8.1S, 9.7E	George Grenier	700	Drl	118	6	..	Pleistocene gravel	45	Jet	3	..	Dom	
Re 421	10Y, 10.5S, 10.1E	Y. M. C. A.	700	Drl	140	6	10	Nassau formation	12	Force	5	..	PWS	Total hardness reported to be 220 parts per million.
Re 422	10Y, 7.4S, 9.0E	A. Perrault	620	Drl	102	6	74	Nassau formation	..	Force	4	..	Farm	
Re 423	10Y, 9.0S, 10.8E	J. M. Mesnig	900	Drl	114	6	57	Nassau formation	37	Jet	4	..	Dom	
Re 424	10Y, 8.2S, 11.2E	H. G. Haskell	900	Drl	400	8	180	Nassau formation	37	Force	10	..	Dom	Drawdown reported 73 feet after pumping at the rate of 10 gallons per minute for 7 hours.
Re 425	10Y, 10.5S, 7.7E	Charles Orr	570	Drl	110	6	18	Nassau formation	18	Suction	5	..	Dom	
Re 426	10Y, 10.9S, 8.1E	William Kenney	660	Drl	173	6	135	Nassau formation	6	Force	4	..	Dom	([g])
Re 428	10Y, 7.4S, 7.3E	Joel Hitchcock	500	Drl	60	6	2	Schodack formation	12	Suction	6	..	Dom	

See footnotes at end of table.

Table 8.—Records of selected wells in Rensselaer County, New York (Continued)

Well number	Location[a]	Owner	Altitude above sea level (feet)[b]	Type of well[c]	Depth (feet)	Diameter (inches)	Depth to bedrock (feet)	Geologic subdivision	Water level below land surface (feet)[d]	Method of lift[e]	Yield (gallons per minute)	Temperature (°F.)	Use[f]	Remarks
Re 430	10Y, 7.5S, 6.1E	S. N. Blakeman	530	Drl	98	6	5	Schodack formation	11	Suction	5	..	Dom	
Re 433	10Y, 7.9S, 7.5E	K. S. Buck	600	Drl	340	6	120	Schodack formation	80	Suction	2½	..	Dom	([g])
Re 434	10Y, 8.0S, 7.6E	William S. Fletcher	580	Drl	174	6	120	Schodack formation	84	Force	4	..	Dom	([g])
Re 438	10Y, 4.7S, 6.3E	Ralph Barringer	400	Drl	169	8	65	Schodack formation	76	Jet	1	..	Dom	
Re 442	10Y, 10.8S, 3.5E	Joseph Bastian	470	Drl	64	6	20	Schodack formation	..	Force	2½	..	Dom	
Re 450	10Y, 9.7S, 2.4E	C. W. Herrington	280	Drl	180	6	30	Schodack formation	35	Force	..	..	Dom	Water has hydrogen sulfide odor.
Re 452	10Y, 9.0S, 2.5E	Charles Neale	300	Drl	145	8	34	Schodack formation	17	Jet	9	..	Dom	
Re 454	10Y, 8.7S, 1.3E	E. T. Newberry	210	Drl	100	6	86	Normanskill shale	25	..	3½	52	Dom	Water has hydrogen sulfide odor.
Re 456	10Y, 7.5S, 2.6E	W. Onderdonk Estate	260	Drl	131	6	85	Normanskill shale	76	Force	2	..	Dom	
Re 458	10Y, 14.9S, 0.9E	Charles Peter	200	Drl	103	6	6	Normanskill shale	13	Force	7	50	Farm	Water has hydrogen sulfide odor.
Re 459	10Y, 14.9S, 0.3E	Fort Orange Paper Company	20	Drl	97	12 to 8	..	Pleistocene gravel	7	Suction	220	..	Ind	Well finished with 20 feet of 8-inch screen, No. 125 slot. Drawdown reported 22 feet after pumping 220 gallons per minute, recovered 21.5 feet in 5 minutes.[g] [h]
Re 460	10Y, 14.5S, 1.5E	Charles Cooper	210	Dug	18	24	..	Pleistocene sand	12	Suction	4	..	Dom	Drawdown reported 4 feet after pumping at the rate of 4 gallons per minute for 12 hours.
Re 461	10Y, 14.4S, 1.7E	Brookview School	200	Drl	326	6	105	Normanskill shale	63	..	1/10	..	None	Water has hydrogen sulfide odor.
Re 465	10Y, 14.4S, 1.0E	Irwin Newkirk	180	Drl	111	6	13	Normanskill shale	9	..	1½	..	Dom	
Re 466	10Y, 13.2S, 3.5E	James Shappey	350	Drl	152	6	117	Schodack formation	35	Force	¾	..	Dom	Water has hydrogen sulfide odor.
Re 468	10Y, 13.2S, 5.1E	Philip Raeder	430	Drl	83	6	14	Schodack formation	10	Force	4	..	Dom	
Re 469	10Y, 7.4S, 1.8E	J. T. May	230	Drl	300	6	40	Normanskill shale	..	Force	3½	..	Farm	Water has hydrogen sulfide odor.
Re 470	10Y, 13.2S, 6.0E	E. Schodack School	440	Drl	200	6	32	Schodack formation	21	Force	2½	..	PWS	
Re 474	10Y, 11.3S, 2.4E	M. Fisher	320	Drl	128	6	95	Schodack formation	53	Force	1½	..	Dom	
Re 475	10Y, 11.1S, 2.3E	East Greenbush Terrace Water Co.	260	Drl	86	8	..	Pleistocene gravel	..	Centrifugal	50	..	PWS	Well finished with a screen. Drawdown reported 4 inches after pumping 50 gallons per minute for 48 hours.[g] [h]
Re 476	10Y, 11.6S, 1.2E	J. Wishart	180	Drl	76	6	13	Normanskill shale	20	..	1	..	Dom	Water has hydrogen sulfide odor.
Re 477	10Y, 11.7S, 0.7E	A. E. Van Patten	100	Drl	38	6	8	Normanskill shale	..	Suction	¼	..	Dom	
Re 479	10Y, 9.3S, 1.0E	Jesse Cunningham	260	Drl	77	6	15	Normanskill shale	15	Suction	1	..	Dom	
Re 481	10Y, 8.7S, 0.4E	L. Tibbetts	150	Drl	102	6	21	Normanskill shale	21	Force	4	..	Dom	Water has hydrogen sulfide odor.[g]

See footnotes at end of table.

Table 8.—Records of selected wells in Rensselaer County, New York (Continued)

Well number	Location[a]	Owner	Altitude above sea level (feet)[b]	Type of well[c]	Depth (feet)	Diameter (inches)	Depth to bedrock (feet)	Geologic subdivision	Water level below land surface (feet)[d]	Method of lift[e]	Yield (gallons per minute)	Temperature (°F.)	Use[f]	Remarks
Re 487	10Y, 14.7S, 4.4E	M. Hacker	430	Drl	64	6	15	Schodack formation	..	Suction	10	..	Dom	
Re 488	10Y, 14.0S, 0.3E	Strong Point School	100	Drl	170	6	..	Pleistocene sand	145	None	0	..	None	
Re 491	10Y, 10.1S, 1.6E	Corliss Realty Co.	270	Drl	130	6	52	Normanskill shale	26	Suction	7	..	Dom	(h)
Re 494	10Y, 16.8S, 6.0E	C. Luxemus	460	Drl	118	6	22	Schodack formation	0	Suction	5	..	Dom	
Re 496	10Y, 16.2S, 8.2E	J. Leberman	590	Drl	65	6	..	Pleistocene till	30	Suction	1	..	Dom	(g)
Re 497	10Y, 15.3S, 7.4E	Philip Kreis	410	Drl	61	6	36	Nassau formation	24	Suction	1/5	..	Dom	
Re 501	10Y, 14.7S, 7.1E	Harry Pickenik	500	Drl	79	6	8	Nassau formation	10	Suction	2	..	Dom	
Re 504	10Y, 14.9S. 8.1E	W. D. Bruschel	480	Drl	175	6	14	Nassau formation	17	Force	2½	..	Farm	
Re 506	10Y, 13.2S, 8.5E	David Justus	620	Drl	148	6	..	Pleistocene gravel	80	Force	5	..	Dom	
Re 507	10Y, 12.3S, 7.8E	Frank Tuecser	520	Drl	157	6	8	Nassau formation	8	Force	10	..	Farm	
Re 509	10Y, 11.8S, 10.7E	Charles Senrick	660	Drl	99	6	80	Nassau formation	15	Force	..	..	Farm	
Re 510	10Y, 12.1S, 11.8E	A. L. Weindel	880	Drl	110	6	7	Nassau formation	15	Force	..	..	Dom	
Re 512	10Y, 14.1S, 9.9E	Samuel Smith	600	Drl	98	6	5	Schodack formation	..	Jet	..	..	Farm	
Re 513	10Y, 14.2S, 11.5E	Rudolph John	700	Drl	260	6	..	Pleistocene gravel	..	Force	..	..	Farm	
Re 517	10Y, 14.3S, 6.2E	J. W. Herring	460	Drl	286	6	135	Schodack formation	18	..	1½	..	Dom	
Re 519	10Y, 15.1S, 6.0E	Edward Kells	500	Drl	166	6	0	Schodack formation	..	Force	..	..	Farm	
Re 521	10Y, 14.1S, 8.9E	Samuel Smith	580	Drl	310	6	6	Nassau formation	16	Force	10	..	Dom	
Re 523	10Y, 15.1S, 8.9E	M. F. Murray	620	Drl	149	6	79	Nassau formation	15	Suction	5	..	Dom	
Re 524	10Y, 16.3S, 12.1E	Abe Friedman	540	Drv	20	1¼	..	Pleistocene gravel	15	Suction	..	..	Dom	
Re 526	11Y, 0.1S, 10.9E	Charles Lacey	480	Drl	168	6	60	Nassau formation	27	Force	4	..	Farm	
Re 527	11Y, 0.5S, 12.3E	K. Light	560	Drl	70	6	28	Rensselaer graywacke	..	Suction	..	..	Dom	(h)
Re 528	10Y, 8.1S, 0.1E	Bayer Chemical Company	10	Dug	37	24	..	Pleistocene sand	4	Suction	115	..	Ind	Well finished with 19 feet of 42-inch screen. Drawdown reported to be 22 feet after pumping 115 gallons per minute for 96 hours.
Re 529	10Y, 7.7S, 0.3E	Huyck & Sons Mills	10	Drl	45	8	..	Pleistocene gravel	..	..	45	..	Ind	
Re 531	10Y, 15.1S, 0.6E	L. W. Hoffman	150	Drl	210	6	124	Normanskill shale	..	..	0	..	None	Driller reports dry hole.[h]
Re 532	10Y, 15.2S. 0.6E	Earl Bristo	160	Drl	57	6	6	Normanskill shale	22	Suction	4	..	Dom	
Re 535	10Y, 12.7S, 2.3E	Harry Stammel	270	Drl	120	6	30	Schodack formation	13	..	6	..	Dom	

See footnotes at end of table.

Table 8.—Records of selected wells in Rensselaer County, New York (Continued)

Well number	Location[a]	Owner	Altitude above sea level (feet)[b]	Type of well[c]	Depth (feet)	Diameter (inches)	Depth to bedrock (feet)	Geologic subdivision	Water level below land surface (feet)[d]	Method of lift[e]	Yield (gallons per minute)	Temperature (°F.)	Use[f]	Remarks
Re 536	10Y, 16.4S, 2.4E	Herman Dederick	260	Drl	101	6	3	Schodack formation	30	Force	4	..	Dom	(h)
Re 537	10Y, 16.5S, 7.0E	Village of Nassau	400	Drl	34	8	..	Pleistocene gravel	6	Suction	140	..	PWS	(g) (h)
Re 538	10Y, 14.3S, 2.8E	J. Van Campen	310	Drl	112	6	..	Pleistocene gravel	40	Force	2	..	Dom	
Re 539	10Y, 14.1S, 4.0E	H. E. Hallenbeck	350	Drl	100	6	45	Schodack formation	22	Force	3	..	PWS	
Re 543	10Y, 8.0S, 0.8E	William Kammer	190	Drl	208	6	162	Normanskill shale	77	Force	5	..	Dom	
Re 545	10Y, 16.0S, 6.0E	M. E. Panitch	400	Drl	200	6	17	Schodack formation	4	Force	2	..	Dom	
Re 546	10Y, 7.5S, 2.7E	William L. Thompson	400	Drl	145	6	3	Schodack formation	..	Force	..	..	Dom	
Re 547	10Y, 17.4S, 6.8E	F. E. McGrath	380	Drl	162	8	25	Nassau formation	..	Jet	..	..	Dom	
Re 548	10Y, 12.8S, 3.4E	Monica Bambrick	370	Drl	150	8	0	Nassau formation	9	Force	3	..	Dom	
Re 549	10Y, 10.6S, 5.3E	Franklin Schacht	480	Drl	93	6	5	Nassau formation	14	Suction	15	..	Dom	
Re 550	10Y, 9.0S, 2.8E	G. A. Fredericks	300	Drl	100	6	45	Nassau formation	12	Jet	2½	..	Dom	
Re 551	10Y, 10.4S, 2.2E	East Greenbush School	200	Drl	105	8	75	Schodack formation	35	Force	17	..	PWS	
Re 553	10Y, 12.0S, 2.3E	D. B. Andrews	160	Drl	103	6	70	Schodack formation	28	Force	3	..	Dom	
Re 555	10Y, 12.0S, 3.0E	Williams Hans	370	Drl	45	6	3	Schodack formation	..	..	..	..	Dom	(g)
Re 556	10Y, 11.9S, 3.5E	Roy Zimmerman	320	Drl	45	6	..	Pleistocene gravel	19	Suction	5	..	Dom	
Re 559	10Y, 12.4S, 3.3E	E. F. Henninger	380	Drl	140	6	14	Schodack formation	25	Force	2	..	Dom	
Re 561	10Y, 11.3S, 2.6E	F. I. Galer	360	Drl	220	6	45	Schodack formation	47	Force	1½	..	Dom	
Re 565	10Y, 15.8S, 5.0E	Prescott Mead	480	Drl	114	6	14	Schodack formation	11	Suction	10	..	Dom	
Re 567	10Y, 16.5S, 6.6E	W. G. Harrington	420	Drl	112	6	46	Nassau formation	17	..	½	..	Dom	
Re 579	10Y, 6.9S, 11.6E	Bert Teal	1,100	Drl	116	8	32	Rensselaer graywacke	45	Force	¾	50	Farm	(g)
Re 585	10Y, 6.8S, 0.8E	Herbert Dumont	100	Drl	67	6	17	Normanskill shale	17	..	1	..	None	
Re 590	10Y, 3.6S, 5.7E	E. F. Malka	490	Drl	99	6	51	Schodack formation	20	..	1	..	Dom	
Re 591	10Y, 3.7S, 5.5E	Tatios Tergian	340	Drl	48	6	..	Pleistocene gravel	4	..	1½	..	Dom	
Re 592	10Z, 0.1N, 9.5W	Collar City Creamery	20	Drl	85	6	15	Normanskill shale	12	Deep-well turbine	..	54	Ind	Water has hydrogen sulfide odor.[g]
Re 593	10Z, 0.8N, 9.3W	Borden Company	30	Drl	28	8	..	Pleistocene gravel	15	Deep-well turbine	200	56	Ind	Three similar wells at this location.[g]
Re 595	10Z, 3.5N, 8.3W	H. A. Geiser	40	Drl	100	8	31	Normanskill shale	35	..	3	..	Dom	
Re 597	10Y, 0.6S, 4.6E	S. S. Engle	410	Drl	86	6	0	Schodack formation	18	None	1	..	None	
Re 598	10Y, 15.6S, 1.7E	Elizabeth Friend	240	Drl	145	8	64	Normanskill shale	25	..	3	..	Dom	
Re 599	10Y, 2.4S, 5.1E	George A. Radz	340	Drl	156	6	97	Schodack formation	..	None	..	..	None	(g)
Re 607	10Y, 5.7S, 6.4E	J. M. Paul		Drl	50	6	10	Schodack formation	12	Suction	1½	..	Dom	

See footnotes at end of table.

Table 8.—Records of selected wells in Rensselaer County, New York (Concluded)

Well number	Location[a]	Owner	Altitude above sea level (feet)[b]	Type of well[c]	Depth (feet)	Diameter (inches)	Depth to bedrock (feet)	Geologic subdivision	Water level below land surface (feet)[d]	Method of lift[e]	Yield (gallons per minute)	Temperature (°F.)	Use[f]	Remarks
Re 608	10Y, 4.4S, 6.0E	Milton Gray	375	Drl	69	6	0	Schodack formation	..	..	30	..	Dom	
Re 611	10Z, 17.3S, 0.7E	August Harlfinger	760	Drl	105	6	..	Pleistocene gravel	17	Suction	9	..	Dom	
Re 613	10Z, 17.3S, 2.6E	A. Tessier	690	Drl	473	6	136	Walloomsac slate	43	Force	2½	..	Farm	
Re 621	10Y, 16.6S, 10.9E	Myers Cohen	820	Drl	60	6	0	Nassau formation	10	Suction	5	..	Dom	
Re 622	10Y, 16.4S, 12.9E	Louis Krasne	600	Drl	99	6	..	Pleistocene gravel	8	Force	42	46	Dom	Well finished with 4 feet of 6-inch screen. Installation of screen increased flow from 7 to 42 gallons per minute.
Re 623	11Y, 0.3N, 0.8W	John Comingo	20	Drl	232	6	70	Normanskill shale	..	None	0	..	None	
Re 624	11Y, 1.4S, 1.0W	Schodack Landing School	80	Drl	159	6	48	Normanskill shale	15	Force	24	..	PWS	
Re 627	10Y, 16.8S, 3.9E	Robert Recker	330	Drl	130	6	30	Schodack formation	..	Force	3½	..	Dom	([g])
Re 628	10Y, 16.0S, 3.6E	Frank Sheehy	280	Drl	90	6	75	Schodack formation	20	Suction	13	58	PWS	
Re 634	10Y, 16.3S, 0.3E	Michael Morgan	170	Drl	130	6	98	Normanskill shale	90	Suction	4	..	Dom	Water has hydrogen sulfide odor.
Re 636	11Y, 1.0S, 0.4W	Joseph Gauseman	330	Drl	50	6	..	Pleistocene gravel	15	Force	9	..	Dom	
Re 637	11Y, 0.3S, 4.8E	Hans Maier	450	Drl	97	6	17	Schodack formation	10	Suction	4	..	Farm	
Re 638	11Y, 0.4S, 3.8E	A. Mark	275	Drl	135	6	64	Schodack formation	..	Force	5	..	Dom	
Re 639	11Y, 0.8S, 3.7E	J. C. Wendt	300	Drl	125	6	65	Schodack formation	45	Force	2	..	Dom	([g])
Re 643	10Y, 12.5S, 7.3E	Adolph Petsch	460	Drl	285	6	0	Schodack formation	..	Force	8	..	Dom	
Re 646	10Y, 12.1S, 6.0E	Samuel Steinberg	580	Drl	180	6	10	Schodack formation	..	Force	..	..	Farm	
Re 648	10Y, 11.2S, 6.8E	Ida Donnely	500	Drl	50	6	3	Schodack formation	..	Suction	..	..	Dom	
Re 650	11Y, 1.5S, 2.3E	Alonzo Parks	230	Drl	92	6	..	Pleistocene gravel	27	..	30	52	Farm	([h])
Re 651	11Y, 0.9S, 8.2E	Walter Bertram	560	Drl	85	6	6	Nassau formation	5	Force	16	..	Farm	
Re 652	11Y, 0.9S, 8.8E	M. Fredenburg	540	Drl	80	6	0	Nassau formation	10	Jet	5	..	Farm	
Re 656	11Y. 0.3S, 11.0E	J. F. McGuire	50	Drl	219	6	180	Nassau formation	..	Force	9	..	Dom	
Re 660	10Y, 9.2S, 4.9E	Edward Hardgrove	450	Dug	15	48	..	Pleistocene till	..	None	..	..	None	U. S. Geological Survey observation well.
Re 661	11Y, 1.4S, 0.8W	A. Grooten, Jr.	200	Drl	144	6	5	Normanskill shale	..	Force	5	..	Farm	Water has hydrogen sulfide odor.
Re 663	11Y, 1.5S, 1.0E	Earl Peckham	240	Drl	99	6	32	Schodack formation	..	Force	8	53	Dom	
Re 664	10Y, 14.7S, 3.8E	Frank Rose	460	Drl	90	6	23	Schodack formation	..	..	4	..	Dom	
Re 665	10Y, 11.1S, 9.5E	Charles Windelspecht	640	Drl	25	6	9	Nassau formation	7	..	9	..	Dom	
Re 666	10Y, 9.5S, 9.3E	Lewis H. Meek	720	Drl	64	6	16	Nassau formation	8	Force	2	..	Dom	
Re 675	10Z, 10.8S, 0.9E	Harry Jasper	1,220	Drl	140	6	..	Pleistocene gravel	30	Force	1	..	None	

[a] For explanation of location symbols see section, "Purpose and scope of the investigation".
[b] Approximate altitude from topographic map.
[c] Drl, drilled; Drv, driven.
[d] Reported average water level.
[e] For explanation of methods of lift and pumping equipment see section, "Recovery".
[f] Com, commercial; Dom, domestic; Ind, industrial; PWS, public water supply.
[g] For chemical analysis see table 6.
[h] For log of well see table 7.